U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

EXPERIMENT STATION RECORD

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With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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LIST OF UNITED STATES DEPARTMENT OF AGRICULTURE PUBLICATIONS ABSTRACTED.

U. S. DEPARTMENT OF AGRICULTURE

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CHEMISTRY.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

Vol. VIII. No. 1.

The Hungarian National Millennium Exposition, now in progress at Budapest and recently visited by the Director of this Office, contains a very creditable exhibition of the history, resources, and business enterprise of a people who for 1,000 years have under great difficulties maintained a lofty spirit of courage and independence. The agriculture of Hungary was well represented in a large main building, with small buildings for dairying, horticulture, and forestry. It was very interesting to find how relatively large a space had been given to the exhibits of the institutions for agricultural education and research. These exhibits were systematically and attractively installed, and showed the methods and results of investigations by means of specimens, apparatus, charts, and publications. The schemes of agricultural education and the appliances for objective instruction were also shown. Investigations on soil chemistry and physics and on veterinary science were very prominently illustrated. Fertilizer analyses, field experiments, studies in vegetable pathology and entomology were among the other subjects included in the exhibits.

The number and quality of the varieties of corn (maize) shown in the general agricultural exhibit would probably surprise many Americans, though the traveler from Vienna to Budapest is somewhat prepared for this from seeing numerous fields of corn along the way. Corn is evidently grown for the grain, and not entirely for fodder as is commonly the case in Germany.

In an exhibit of spraying apparatus the knapsack sprayer was appropriately placed on the back of the figure of a woman. The burdens of agriculture which this sex has to bear seem to increase as we go eastward. Carrying a knapsack sprayer would be an easy task for shoulders accustomed to bend under far heavier loads.

The Hungarians are now giving much attention to the breeding of horses, royal patronage and encouragement being largely extended to this industry.

The experiment station movement has spread to German East Africa, where a station has recently been established at Usambara. The object is to determine the adaptability of the country west of the Luengera

to tropical culture, general agriculture, and stock raising. Experiments are to be made at different altitudes with native and introduced tropical plants to determine those best suited to cultivation in that region, and the crops best suited to general farming and to stock raising. Later the station is to supply these plants and seeds on a commercial scale. In addition to this, economic problems are to be considered to ascertain how far the country may be suited to the colonizing of German settlers, the amount of capital required to start in different kinds of farming, and the probable profits.

The suggestive article on the physiological rôle of plants by Prof. Edmond Gain, of the University of Nancy, France, in the present number of the Record, is one of a series of articles on subjects relating to physiological botany, prepared, at the suggestion of this office, by eminent experts, to aid our agricultural experiment stations in organizing investigations with a view to working out more completely the physiology of cultivated plants. The need and importance of work in this line have been previously dwelt upon in the Record. It is encouraging to note that a number of stations are beginning to develop inquiries in this direction, and there is good reason to believe that before long results of scientific and practical interest will be attained. One notable phase of the movement to consider more closely the vital functions of plants in the hope of ultimate benefit to agriculture from such studies is well brought out in the article under consideration. Increased activity in researches in physiological botany is coincident with the systematic attempt to establish inquiries in soil physics on a firm basis and with a great awakening of interest regarding the problems of irrigation in both arid and humid regions. The scope of agricultural science is thus being greatly widened, and at the same time the need of coöperative effort by scientific workers in different lines is being emphasized. Additional reasons are constantly being presented for the more thorough organization of the individual experiment station on a plan which will enable it to group its work around some central leading idea, each worker contributing his share to the solution of some important problem of agriculture. It is daily becoming more incomprehensible why any station should pursue an irregular or hit-or-miss policy, or why public funds should be wasted in so-called practical experiments which in the nature of the case can only bring disappointment to both investigator and farmer. We commend the article of Professor Gain, as well as the other articles of this series, not only to specialists in physiological botany, but also to managers of experiment stations who are seeking to improve and strengthen their work.

THE PHYSIOLOGICAL RÔLE OF WATER IN PLANTS.

EDMOND GAIN,

Professor of Agricultural Physiology and Chemistry, University of Nancy, France.

Water plays an important rôle in the growth of plants, and if we consider the possibility of controlling its distribution by means of irrigation, the practical interest attached to an exact study of its function in plant growth becomes apparent.

The question is very complicated from a theoretical point of view. If considered merely from the side of application of water, there are many difficulties due to the varying requirements of each of our cultivated plants.

While morphologically plants of the same or even different species may agree, the physiological characters are very dissimilar, and it often happens that the physiological requirements of varieties of the same species are totally unlike. By selection and hybridization we are enabled to produce races and varieties having very different characteristics. In the process of acclimatization certain secondary morphological characters are developed which are often retained by the plant in its struggle to adapt itself to its surroundings.

Gaston Bonnier,[1] of the University of Paris, has shown the convergence of morphological types under the influence of cold, due either to latitude or altitude, and that plants upon mountain tops and in polar regions have analogous structures.

J. Vesque[2] has established the fact that inherited characteristics have little to do with the adaptation of plants to drought and that there is no genus, however small, all the species of which are adapted in the same degree to a given physical environment. This biological principle is cited to show the necessity for repeated experimental research in order to elucidate the rôle of water in the growth of cultivated plants. Consideration of it will also prevent too hasty generalization from conclusions which pertain to a single species. Exact information is necessary as to the species under experiment, as well as the variety and race, also the country whence the seed, tubers, bulbs, etc., came. In regard to reproduction by cuttings, the writer does not believe there is an

[1] Rev. gén. Bot., 6 (1894), p. 505; Compt. Rend., 113 (1894), p. 1427.

[2] L'absorption de l'eau et la transpiration, Ann. Sci. Nat. Bot., ser. 6, vol. 4, p. 89; vol. 6, p. 169; vol. 9, p. 5.

invariable transmission of ancestral characteristics. He thinks that the cutting will produce an individual subject to variation to just the extent that the new conditions of life prove more advantageous than the old. This applies equally to reproduction by grafts or from cuttings.

A difficulty in physiological experimentation has recently been pointed out by Prof. Raulin,[1] of the University of Lyons. He has demonstrated that the chemical nature of the soil influences the seed of plants grown upon it, and this influence may be felt for many generations. In this way some of the widely divergent results of experiments may be explained.

Due weight must be given to such preliminary considerations, since we can not be too careful in determining all the conditions likely to affect the results of agricultural experiments. If we wish to give true scientific exactness to the results, it is necessary to avoid the sources of error of every sort which are so numerous in biological researches.

Liebig was the first to formulate clearly the rôle of water. He stated the function to be twofold. It is a food material and also an assistant to the growth of plants.[2] The protoplasm of the cell, as well as the cell walls, contains a certain amount of water. In other words, water is an integral part of the cell in certain definite proportions. These proportions must be maintained or the plant suffers.

As water is furnished the plant by the soil, we shall discuss consecutively the two following points: Water of the soil and water of the plant, adding finally some suggestions relative to irrigation.

WATER IN THE SOIL.

Water acts in 3 different ways. It exercises a physical action and is at the same time a chemical and a biological agent, the nature of its action varying with the quantity present.

The soil receives water by precipitation and by absorption. It loses it by evaporation and drainage. The difference between the loss and gain constitutes the reserve for the use of plants. Many methods have been proposed for the estimation of the extent of this reserve, among others by Maurice de Genève (1797), Gasparin (1822),[3] and Pagnoul (1880).[4] The method of the latter consists of direct weighing or measuring in the case of small plants. A method proposed by Director Risler,[5] of the Agronomic Institute of Paris, consists of measuring the flow from

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[1]Ann. Sci. Agron., ser. 2, 1 (1896), p. 410; Jour. Agr. Prat., 60 (1896), Nos. 30, p. 113; 31, p. 151.

[2]See also Recherches sur le rôle physiologique de l'eau dans la végétation, Ann. sci. nat. Bot., 1895; Modes d'action de l'eau du sol sur la végétation, Rev. gén. Bot., 7 (1895), pp. 71–138.

[3]Gasparin, Cours d'Agriculture, vol. 1.

[4]Pagnoul, Ann. Agron., vol. 7 (1881), p. 20; Bul. Météorologique du Pas de Calais, 1880.

[5]Risler, Évaporation du sol et les plantes; Archiv. sci. Bibliothèque universelle, 1879.

drains from a given surface of land and comparing it with the water which falls upon the same surface, as shown by the rain gauge. Knowing the amount of drainage and the water content of the soil, the amount of evaporation may be calculated. In order that this method may be reliable it is necessary that no other water than that falling directly upon the surface be measured, also that all the water of filtration be collected by the drains. There is one source of error—poorly drained soils absorb less water than well drained. The water will penetrate only where the condition of the interstices allows it to descend and displace the air filling them. Now, it has been demonstrated that drains increase the number and diameter of interstitial spaces. The drains offer a means of escape for the air which the water displaces and afterwards in a measure suck out the water of the soil by virtue of the vacuum which tends constantly to form at their upper ends.

Experiments were made by Risler on soil cultivated in wheat, clover, alfalfa, and potatoes. The gauging of the drain which collected all the water was made daily at noon. The number of seconds required to fill a vessel of 4 or 5 liters was determined and it was assumed that the amount of water collected per second remained constant during the preceding 24 hours. This is only exact when the drains collect a diminishing amount of water for a number of days. Whenever there are heavy rains a number of measurements should be made daily. Risler's tables show that the average evaporation amounted to 70 per cent in 1867 and 1868. Maurice de Genève found it to be 61 per cent and Gasparin 88 per cent. These figures are comparable, and show that evaporation amounts to about 70 per cent of the rainfall. These experiments should be carefully repeated with different crops upon soils of different chemical constitution, with differing inclination and exposure, as well as upon bare soil. The effect of heavy rains and long-continued gentle rainfall should also be compared. It is probable that very different results might be obtained which might have an important bearing on determining the quantity of water to be subsequently distributed by irrigation. Just here, at the outset, there is a serious lack of precise data.

Experiments of this character are worthy of especial consideration by agricultural experiment stations able to conduct them on an extensive and varied scale. The results will be of still greater value if advantage is taken of recent investigations relative to the influence of fertilizers upon the movement of soil water. Numerous investigators, especially Lawes, Gilbert, and Warington,[1] Frankland, Berthelot,[2] and Dehérain,[3] have undertaken to determine from examinations of the drainage water the time required to render soluble the chemical principles in fertilizers, the optimum economical quantity of fertilizers to be used, the loss of nitrates in the soil, etc. There still

[1] Warington, Jour. Roy. Agl. Soc., 17 (1881), p. 241.

[2] Compt. Rend., 105 (1887), p. 690.

[3] Dehérain, Ann. Agron., 16 (1890), p. 337; 17 (1891), p. 49.

remains much to be learned of the chemical composition of the soil solution. The suggestive researches of Schlössing[1] made in the laboratory should be repeated upon soils in place. The influence of the subsoil upon the moisture of the soil should be considered. The investigations of Pagnoul[2] are of interest in this connection to both agriculturists and botanists, since they deal with the effect of different soils upon the spontaneous geographical distribution of plants. Here is found a key to the preferences of certain plants for particular soils. The ideas advanced concerning this question have been far from satisfactory, and it is suggested that the analysis of the drainage water will materially aid in its solution.

In general the amount of water retained by a soil depends upon its physical texture and chemical composition. Near the surface there is ordinarily found from 25 to 35 per cent of water in soils in place, although the coëfficients determined in the laboratory by the method of Schübler give about 50 per cent. These numbers are given in terms of weight, but from a biological standpoint the amount in terms of saturation is preferable.

Concerning the capacity of soil for water, absorption, evaporation, and hygroscopicity the conclusions of Wollny[3] are as follows: (1) A compact soil loses more water by evaporation than a loose one, because the capillary spaces are smaller in diameter and more easily conduct to the surface the water in the deeper layers. On this account the surface of a compact soil remains moist longer than a loose one. (2) A compact soil has a greater capacity for water than a loose one, although it is less permeable. The capillary spaces are smaller, the number of water pores are increased, and the penetration of water into the subsoil is hindered. (3) A compact soil offers more water for the plant than a loose one. When it is desired to increase the capacity of a soil for water it must be made more compact.[4]

The susceptibility of soil to drought is represented by the proportion between the water lost by evaporation and the maximum weight of water it is able to hold. Schlössing[5] has pointed out the important facts that the size of the soil particles and the degree of humidity exert an influence on the amount of water transported toward the surface. The fineness of the superficial layer[6] also modifies evaporation.

It is apparent that the greater the coëfficient of evaporation the less the water capacity of the soil. The capacity for water varies directly as the hygroscopicity. The hygroscopic capacity and the tension of the water vapor varies with the size of the soil particles, being greatest

[1] Compt. Rend., 63 (1866), p. 1007; 70 (1870), p. 98.

[2] Ann. Agron., 7 (1881), p. 21.

[3] Forsch. geb. agr. Phys., vol. 5, p. 1.

[4] Edmond Gain, Précis de Chimie Agricole, p. 57.

[5] Enclycl. Chimique de Frémy—Chimie Agricole.

[6] Chabaneix, Influence de l'ameublissement superficial sur l'évaporation.

where the soil particles are largest. The following table[1] shows the coëfficients of absorption, hygroscopicity, and evaporation for various types of soil:

Coëfficients of absorption, hygroscopicity, and evaporation in soils.

Absorptive capacity:	
Sand	25.0
Clay	40.0
Lime	70.0
Garden soil	89.0
Humus	190.0
Coëfficients of hygroscopicity:	
Calcareous sand	1.5
Garden soil	26.0
Clay	17.5
Humus	60.0
Coëfficients of evaporation:	
Sand	90.0
Fine garden soil	80.0
Lime	65.0
Clay	35.0
Humus	20.0

To sum up, water is a physical agent which modifies the texture of the soil and influences its aëration, density, cohesion, etc. Water also acts chemically upon the constituents of the soil. In aërating the soil it at the same time introduces ammonia and carbon dioxid, two essentials to fertility, which facilitate the solution of the organic and mineral materials necessary to the plant. The organic materials are rapidly destroyed by the oxygen of the air and the nitrogenous matter is transformed into nitrates, which are partly absorbed by the plant. The mineral constituents undergo modifications no less important. Phosphate of lime is dissolved and the silicates are decomposed by the water charged with carbon dioxid.

It is possible to conduct interesting experiments on this action of water by analyzing at different times the solutions which exist in irrigated soil. By systematically repeating these analyses through a series of years it will without doubt be found that irrigation water exerts a steadily diminishing power.

Water is not only a solvent which sets free certain oxids, alkalies, phosphoric acid, and silica, but is a vehicle for the fertilizing elements intended for the roots of plants. Water, therefore, is essential to the utilization of fertilizers. A soil responds very differently to chemical fertilizers under different conditions. The fertility will be considerably increased if there be enough water present to act as a vehicle for the fertilizing substances, while there will be little improvement if the soil is subjected to an extreme drought. Moreover, for certain fertilizers too abundant irrigation is injurious in that the fertilizers are washed

[1] Edmond Gain, Rev. gén. Bot., 7 (1895), p. 123.

into the subsoil. The natural fertility of the soil may also be exhausted by irrigation.

There is need of experiments to show the fertilizers best adapted to dry soils and to moist or irrigated soils.

The experiments of Lawes and Gilbert, reported by Dehérain,[1] illustrate this point. An average of 1.63 meters of water falls at Rothamsted during April, May, and June,[2] but in 1870 the rainfall for that time was only 76 cm. The harvest of hay was very light on the soils without fertilizers and also on those which received phosphates and salts of ammonia. There was a smaller deficit on the plats that had received nitrate of soda, as the following table shows:

Effect of fertilizers on yields in dry and normal seasons.

Fertilizer used.	Yield of hay per hectare.		Deficit.
	1870 (dry year).	Average, 14 years.	
	Kg.	*Kg.*	*Kg.*
No fertilizer	725	2,771	2,046
Mineral fertilizer, no nitrate	3,625	6.527	2,902
Mineral fertilizer and nitrate of soda	7,000	7,250	250

From this it appears that the deficit was almost nothing for the soils receiving nitrate of soda. Under its influence the plants are enabled to send down roots to take some of the water from the subsoil, which is usually moist even in years of extreme drought. France experienced in 1892 and 1893 two seasons of prolonged drought, and all experiments showed that the subsoil always retained considerable water at a depth which was readily accessible to deep-rooted plants, such as wheat.[3]

At Rothamsted in 1870, on the meadows which we have just mentioned, the following data relating to moisture in unfertilized soil were obtained: At depth of 22 cm., 10.8 per cent; 44 cm., 13.3 per cent; 66 cm. 19.2 per cent; 88 cm., 22.7 per cent; 110 cm., 24.2 per cent.

This indicates that in the case of drought plants will not perish if they are able to develop roots which descend to a sufficient depth. They are not likely to suffer even on a plat without fertilizers if their roots descend to a depth of 66 cm. In soils rich in nitrates plants have roots 1.3 meters long, and through these they take up large quantities of water from the subsoil, which may contain 25 per cent moisture at this depth. For this reason, as well as because they are washed out of the soil in a wet season, nitrates are most effective during rather dry seasons.

[1] Chimie Agricole, p. 665.

[2] Lawes and Gilbert, Ann. Agron., 1 (1875), pp. 251, 551.

[3] Compt. Rend., 1892 and 1893, May to September.

Warington[1] has shown the comparative value of ammoniacal nitrogen and nitric nitrogen on dry soils, moist soils, light sandy soils, and marl soils. A dry soil is influenced to a somewhat greater degree by the nitrates than by ammonia salts, while the converse applies to moist soils. Warington's results were as follows:

Action of nitrate of soda and ammonia salts in dry and wet seasons.

Fertilizer used.	Harvest of wheat at Woburn.	
	Dry season.	Wet season.
	Hectoliters.	*Hectoliters.*
Nitrate of soda	23.45	31.57
Ammonia salts	28.86	23.56

It is unnecessary to multiply researches on this point. It is evident that as regards fertilizers there is an opportunity for selection with reference to special conditions which will greatly increase the profit from their use.

The results of fertilizer experiments must not be accepted as infallible. Duclaux[2] has said that "the meteorology of a region influences the vegetation more than the geology," and we believe that under different climatic influences fertilizers will give different results.

The life of a plant is in effect the resultant of a number of physical conditions acting in conjunction. For example, the action of water will not be the same during a hot and a cold season nor in a moderately cold temperature and a tropical region. The exact knowledge of the influence of water on the phenomena of vegetation, therefore, requires a comparative study of this influence as affected by such factors as temperature, light, fertility of soil, etc.

The fertilizing substances are partially absorbed and retained by the soil and partially dissolved. It is known that drainage water carries off only a small portion of potash, the quantity thus removed being least in well-manured soil. The potash is retained not only by the humus but also by the clay colloids. With an excess of water in the soil the solvent action is largely increased, as shown by the experiments of Gasparin and of Berthelot and André. While the soil, therefore, may contain large quantities of soluble potash it is retained with such energy that enormous quantities of water are necessary to dissolve it. The solubility of the potash is greatly increased if some sulphate such as gypsum is added to the soil.

Way[3] has shown that the quantity of ammonia absorbed by a soil is nearly constant when the solutions present have the same concentration,

[1] Ann. Agron., 15 (1889), p. 213.

[2] Relation entre la météorologie et la géographie, Ann. Geog., 1894.

[3] Jour. Roy. Soc. Agr. England, 1850, p. 313.

but that the force with which the soil absorbs alkalies varies with the concentration of the solutions. Brustlein[1] has shown that soils are not able to remove alkali completely from its solution in water. These solutions circulate to a considerable extent in the soils without undergoing decomposition. This explains how water brings to the plant the chemicals needed in very great dilution. Potash and ammonia are easily retained as carbonates by the soil but less readily in the form of sulphates.

When a solution of acid phosphate of lime comes in contact with sand, a portion of the phosphate is rapidly absorbed; but absorption is not complete for at least 25 days. Still it is believed that there is little serious loss of phosphates by drainage following a heavy rain even in sandy soils, while with lime and clay soils the absorption is naturally more rapid and complete.

The influence of the water of the soil upon the microörganisms which play a part in the fertility of the soil remains to be mentioned. The experiments of Berthelot[2] show that the nitrogen of the air is fixed through bacteria in non-sterilized soil; and Hellriegel and Wilfarth, Bréal, Schlössing, and Laurent have shown that the bacteroids in the root tubercles of leguminous plants are able to fix free nitrogen. It is known that the phenomena of nitrification takes place in 3 steps—formation of ammonia, nitrites, and nitrates[3]—under the influence of bacteria, yeasts, algæ, and the ferments of Winogradsky. *Bacillus mycoides* is aërobic, and able to produce ammonia in the presence of organic nitrogen, but it becomes a denitrifier and anaërobic when there exists in the soil rapidly reducible substances, such as nitrates.[4]

These investigations show that the lower organisms play an important rôle in the fertility of the soil. Water in varying quantity has an influence on the biology of all these organisms. Schlössing and Müntz[5] have shown that nitrification requires a certain amount of moisture, and the writer's[6] investigations have shown that the vitality of *Rhizobium leguminosarum* is influenced by the water content of the soil. For each soil there is an optimum humidity. Too great dryness checks or entirely prevents the formation of tubercles. Excessive moisture produces an analogous effect, though less marked. The writer has shown that the formation of the tubercles begins soon after the development of the plant, and it is therefore of highest importance to furnish the young leguminous plant with sufficient water.

As regards the variations in ammonia formation with varying proportions of water, it would appear *a priori* that the results should be analogous to those cited in the case of nitrates.

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[1] Ann. Chim. et Phys., ser. 3, vol. 56, p. 497.

[2] Compt. Rend., 101 (1885), p. 775; 110 (1890), p. 558. Ann. Chim. et Phys., ser. 6, vol. 11, p. 375; vol. 16, p. 490.

[3] Edmond Gain, Précis de Chimie Agricole, p. 74.

[4] E. Marchal, Production de l'ammonia dans le sol, 1894 (E. S. R., 5, p. 614).

[5] Schlössing, Encycl. Chimique de Frémy—Chimie générale (nutrition de végétaux).

[6] Rev. gén. Bot., 7 (1895), p. 123.

We think the time has arrived to study with greater care the absolute value of the different optima which are recognized in biology. It is well known that there are optima of temperature, of light, of plant food, and of humidity with which to realize the best possible growth of the plant, but only in rare instances have the values of these optima been definitely fixed. It has been considered sufficient if we knew the optimum temperature for the germination of our cultivated plants.

WATER IN THE PLANT.

The water of the soil penetrates the plant, being drawn in through osmosis and the aspiration resulting from the transpiration of the leaves. Transpiration assures an exit for the greater part of the water absorbed. The amount of water in the interior of the plant therefore depends on the relative intensity of absorption and transpiration. If the water taken in by the plant diminishes, that given off will also diminish, but more slowly and in less amount. There is then produced a kind of dehydration, which, through the organic balance, tends to increase the osmotic entrance of water for the reëstablishment of the equilibrium of concentration of the internal solutions. If there should happen to be at the time a lack of water in the soil, the normal hydration of the tissues is not sustained, and we say that the plant suffers from drought. On the other hand, transpiration being excessive and absorption limited the equilibrium of the sap current is disturbed, resulting in a temporary drying up, which becomes permanent if the cause persists for a long time. The plant, on the other hand, suffers from excess of moisture because there is a lack of aëration of the underground system. Certain plants are specially adapted morphologically to resist drought and to maintain a constant proportion of internal moisture. This adaptation consists in the provision of morphological mechanisms, which are designed to prevent too great variation in transpiration, as is admirably shown in desert plants, which as a rule contain a normal amount of water and are not dried out as they appear to be. The means employed by the plant to control transpiration are well known but very variable. The leaves are greatly reduced in size, or thickened as in fleshy plants, in order to reduce the transpiring surface or to increase the reserve water; the stems are gradually lignified, the stomata are placed in protective depressions, the greatly developed trichomes form a protective screen, the epidermis has a thickened cuticle, the reserve water is stored up in special reserve tissues or in the root, which is proportionately developed. J. Vesque[1] has discussed this special adaptation of the plants to different water conditions, showing that plants change their structure in order to adapt themselves to diminished water supply.

[1] Anatomie des tissus appliquée a la classification des plantes, Nouv. Archiv. du Museum, n. ser., 4 and 5. L'espèce au point de vu de l'anatomie comparée, Ann. sci. nat. Bot., ser. 6, Vol. XIII. Numerous papers on the rôle of water, Ann. sci. nat. Bot.

Another factor which is no less important is the capacity of soil for water. For the same proportion of water soils of different natures, as already explained, possess different coëfficients of hygroscopicity, permeability, and liability to desiccation.

The early experiments of Sachs[1] show that tobacco suffers when the water content of clay soil is 8 per cent and of sand 1.5 per cent. The writer has repeated these experiments with many plants in order to settle the following questions: (1) Is the power of resistance to drought of a given plant the same in different soils? This question must be answered in the affirmative. (2) Is the water content of the soil at the time when plants wilt the same for all stages of plant growth? No; it fluctuates in such a way as to produce a curve. These two questions are interesting to agriculture from the point of view of rational irrigation.

The following plants become dry and suffer from drought with the given water contents of the soil:

Water contents of soils at which different plants begin to wilt.

Soil.	Phaseolus vulgaris.	Erigeron canadensis.	Lupinus albus.
	Per cent.	*Per cent.*	*Per cent.*
Peaty	10.60	9.40	11.10
Clay	9.58	7.78	11.35
Humus	5.92	6.83	6.95
Lime	2.90	4.25	5.23
Garden	1.88	2.40	2.91
Sand	0.35	0.48	0.75

The writer would urge agricultural experiment stations to make experiments analogous to these with different cultivated plants. The following plan is suggested: Establish a series of experiments on typical soils and on the mixed soils which are found at the stations. In order to eliminate the influence of the subsoil, use pots about 80 cm. in diameter and about 80 cm. in depth. Large barrels cut in two serve the purpose well. Bore 5 or 6 holes of about 4 cm. in diameter in the bottoms for aëration, and place the tubs in holes in the ground upon supports about 20 cm. in height, so that the edge of the tubs will be about on a level with the surrounding soil. For each plant experimented with 2 series of 10 pots each will be required. In the first pot place clay soil, in the second lime, in the third humus, in the fourth clay, in the fifth peat soil, in the sixth garden soil, and in the seventh, eighth, ninth, and tenth mixed soils. The two series should give the same results. If they do not, a possible error is indicated. Many experiments may be made during the year with different varieties of the principal cereals. If it is desired to study 5 varieties of wheat, 100 pots will be required. The plants should be studied from the two points of view stated above. It is necessary to note the point at which wilting occurs during each stage of growth, taking samples of soil and

[1] J. Sachs, Physiology of Plants. Translated by H. Marshall Ward, 1887, p. 258.

determining moisture for this purpose. The exact state of drought which causes positive injury to the plant should also be determined.

By watering plants wilted to different degrees and at successive periods of vegetation it may be possible to establish morphological characteristics of the highest interest. It may thus be shown how a plant is affected under the influence of alternate drought and humidity, and how plants behave upon different soils, as well as what is the result of permanent and excessive drought or humidity and of judiciously combining drought and humidity. The author has conducted general experiments along this line, and it may be of interest to discuss the conclusions from this work in its agricultural bearings.

In order to apply these conclusions to agriculture it is necessary to know what cultivated plant is to be especially studied—*i. e.*, whether a cereal, a forage plant, or a tuber-bearing plant. It is possible to deduce a correct rule of irrigation based upon a curve showing the water requirements of the plant under consideration for each period of its growth, but there is a considerable difference between the necessary water which a clay soil and a sandy soil must possess to prevent plants from drying out and dying from drought. In the author's experiments it was found that clay soil requires more than 11 per cent of water to prevent lupines from perishing, while 1 per cent suffices in a sandy soil. The hygroscopicity of sand being practically nothing, the water which is found in a sandy soil is all available for the plant. In other words, in a clay soil there is from 10 to 11 per cent of moisture which is not available to lupines, since about 10 per cent is retained by the hygroscopic action of the soil. For different plants this amount varies, being 11 per cent for lupines, 7.7 per cent for Erigeron, and 9.6 per cent for beans. These variations are as great for different soils as for different plants.

If K represents the capacity of the soil for water, a the hygroscopic water of the soil, the maximum amount of water available to plants per 100 gm. of soil will be $Q=K-a$. It is this value of Q which is of great importance from a biological standpoint in experiments on the rôle of water in the physiology of a given species of plant. It will be found that a varies from 0 to 15 and perhaps more. It is apparent then that it is important to know the value of this factor for different species of plants, since it determines so largely the value of Q. In general the soil should not be saturated, but ought to contain about $\frac{1}{n}$ of K, and in rational irrigation the effort should be to realize the optimum value of $\frac{1}{n}$, which in this case is $Q+a=\frac{K}{n}$. As already observed, the proportion of water in the soil which is not available to the plant should be determined.

In a locality which receives a certain average rainfall and is subject to a period of drought, the same species of plant will show different conditions of growth according to the nature of the soil. In humid countries, such as Ireland, those soils which contain most silica are regarded

as best for wheat; and in dry countries, such as Italy, those which contain most alumina. The sandy soil does not draw up or retain moisture, which is not needed in the north, while the alumina conserves the somewhat deficient moisture of the southern region.

There is an evident relation between the quantity of water which circulates in a plant and the dry matter elaborated. This relation is as yet little understood. Dehérain, repeating the experiments of Haberlandt, has found that 1 kg. of dry substance is elaborated by a plant on an unmanured soil for every 680 kg. of water transpired by the plant, and for every 220 kg. of water upon the same soil when manured. Wollny has also studied this question on manured and unmanured soils. Hellriegel has found that there exists an optimum for the production of dry matter in plants, and that the product varies according to the amount of moisture. Representing by 100 the quantity of water necessary for a complete saturation of the soil, Hellriegel found that the production of dry matter in barley varied with different water contents of the soil as indicated in the following table:

Dry matter in barley on soil with different water contents.

Moisture in the soil	Yield in dry material.	
	Grain.	Straw.
Per cent		
80	8.77	9.47
60	9 96	11.00
40	10.51	9.64
30	9.73	8.70
20	7.75	5 50
10	.72	1 80
5	....	.12

The table shows that the optimum humidity is not the same for grain and straw. These results show that in the case of two soils, the one containing 30 per cent and the other 60 per cent of water, more grain would be grown on the first plat than on the second.

If experiment stations would conduct upon a large number of plants the experiments described above, results of great practical value would be secured. For example, with two dry soils containing from 10 to 15 per cent of water and capable of irrigation, what should be the method followed? Will it be necessary to continue a humidity of 60 per cent during the entire period of growth? The author's experiments show that there are many possible ways in which to secure a maximum yield. To give water to a plant at the proper time after a slight drought gives better results than maintaining a permanent optimum humidity. Periods of relative humidity and drought are in general very advantageous to plants, and the number of land plants which require a permanent humidity for maximum production is very small. It may be asserted as established that (1) for a given plant an interruption, however short, during a dry period proves very beneficial, and (2) some plants which require a certain amount of humidity during one

period are able to resist drought to a considerable degree during the following periods of their growth. The results of numerous horticultural experiments prove this statement.

The different organs of the same plant vary in their requirements. The optimum humidity for the individual, therefore, is not the same for all stages of growth, nor for each organ of the plant. Not only has each part of the plant certain characteristics peculiar to itself, but at a given time different organs of the same plant are in different stages of development.

It is thus seen how extensive is the field of investigation in this line. There is need of investigation of such questions as the following: With a given species of plant in a given soil what amount of moisture must be supplied during each stage of growth in order to obtain the best result for each plant organ? For example, for sugar beets in a clay-lime soil how much water must be given during the 3 months of growth in order to secure the maximum production of foliage or in order to obtain the maximum amount of sugar?

The general formula which is given above may serve to suggest a large number of practical experiments. To determine a question of this kind it is simply necessary to make comparative cultures in the open soil and in pots. The effect of different moisture conditions is noted—resorting to chemical analysis if it is a question of determining the constituents of a plant, or simply weighing the products if only to establish the gross returns. The following is an important question which may thus be studied: What is the proportion of crude and digestible fiber obtained by different methods of irrigation applied to plants in natural meadows and to the same plants in artificial meadows? This question is of vital importance to the rational feeding of animals, since it permits a comparative valuation of forage plants grown under known conditions.

The proportion of the internal water influences not only the dry weight of the final product but also modifies completely the chemical nature of certain of the elaborated materials. This influence should be the subject of further study. If a plant is grown under different moisture conditions, it will be found that the relative quantity of certain intermediate products will also differ. The production of glucosids, tannins, essential oils, fats, alkaloids, and coloring material is particularly influenced by drought and moisture.[1] The production of sugar and organic acids in the fruit and in the sap also varies under the same influence. The author's analyses have shown that the production of chlorophyll is different upon dry and wet soils, a fact which explains many other variations in the elaborated materials of the plants. Illustrations of the above facts are found in the experiments of Lawes and Gilbert, Dehérain, and Lechartier on the comparative chemical

[1] E. Gain, Sur la matière colorante des organes souterrains, Bul. Soc. Bot., France, 40 (1893), p. 95.

composition of cereals and potatoes during dry and wet years. According to Dehérain the spikes of oats contained 12.37 per cent of nitrogen in 1879, a dry year, and only 6.50 per cent in 1878, a very wet year, the conditions being otherwise the same.

In comparative experiments with tobacco, Mayer[1] studied the influence of water upon the production of nicotin, and found that the more moist the soil the less the nicotin. The percentages of nicotin in dry matter of tobacco grown on 3 soils containing different amounts of water were as follows: In the first, 2.7 to 3.1 per cent; in the second, 1.45 to 1.75, and in the third, 1.05 to 1.02. The total dry matter varied with the nicotin content, but not proportionately. This indicates that without injuriously affecting the growth of the plant the formation of nicotin may be greatly reduced. In the tubers of artichokes the content of potash and phosphoric acid is greater in moist than in dry years.[2] In a dry year the leaves are rich in phosphoric acid, the amount in the tubers being proportionately small.

For each period of growth of an organ of a plant, therefore, there is a certain definite portion of internal water necessary for normal and healthy condition, the same being true for each stage of development of the entire plant. Water produces in the organ or plant under consideration a state of turgescence and normal hydration. This turgescence is produced in each vegetative stage by variable proportions of water, as has been shown by the author's investigations as well as those of Gelésnoff,[3] Sorauer,[4] and Jumelle.[5] The study of the variation in the water content of plants is necessary, therefore, in order to determine how water may be most economically and advantageously distributed by means of irrigation. From the results of his experiments the author has been able to draw curves for the development, respectively, of the hypocotyle, cotyledons, root, stem, and leaves. He has also studied the development in general of the entire plant. These curves are based on the proportion between dry weight and total weight of each organ at different periods of growth, noting also the duration of the different stages of growth.

The root usually presents a weakened condition at the flowering period, at which time there is a transfer of substances toward the flowers. This weakening remains for a considerable time and is especially marked if the plant is upon a very dry soil. If, after flowering, the root is furnished with an increased supply of moisture, the period of growth is stimulated and prolonged. When the root prematurely dries, the vitality of the entire plant is soon checked.

Roots play a rôle in regulating the water content of the aërial part. If the quantity of dry weight tends to become too great, the root

[1] Landw. Vers. Stat., 38, p. 453.

[2] Ann. Agron,, Feb., 1892.

[3] Quantité et répartition de l'eau dans les organes des plantes, 1876.

[4] Influence de l'abondance ou du manque d'eau, Bot. Ztg., 1878, p. 14.

[5] Sur le développement des plantes annuelles, Rev. gén. Bot., 1889.

furnishes the water necessary to establish equilibrium in the aërial portions of the plant. It is interesting to note that plants well adapted to withstand drought are nevertheless likely to profit by a supply of moisture. This is true of buckwheat.

If the proportion of the water of the root be compared with that of the stem it will be seen that (1) humidity favors a general development of the plant in weight, and (2) the influence is greatest on the aërial part of the plant. For two stems of the same weight there will be the greatest development of the root in a dry soil.

The most active growth in a plant precedes slightly the flowering period. A more or less abundant supply of moisture favors this growth to some extent, but in any case at the time of flowering the water content of the plant is approximately the same for a given species whatever the water supply. The flowering period is a time of unusual transpiration, which produces a diminution in the proportion of internal water. This is a very critical period, in which desiccation may go so far as to arrest assimilation and completely check the increase in weight. If the plant is furnished with sufficient water to carry it over this period, not only will its vitality be continued during fruit bearing, but ordinarily it will push out new branches and new leaves, the action of which may be prolonged a considerable time after the period of flowering. The beginning of flowering is, therefore, a critical period which decides the weight of the final product, the fresh and dry weight doubling in a very short time. Internal desiccation, however slight, is an obstacle to this growth and influences the maximum product of the plant.

Considering now the phenomena of growth as distinguished from increase in weight, we see (1) that although a saturated soil produces a rapid swelling of seed, germination is generally checked, principally on account of a lack of aëration in the soil; (2) that a soil which is about half saturated greatly favors germination; and (3) that a dry soil in which there is sufficient water to cause the seed to swell, but in which that removed by evaporation is not restored, gives a germination almost as rapid as a semisaturated soil, but the subsequent growth is considerably checked through lack of water. When, therefore, the optimum conditions are departed from growth is generally checked, but to varying degrees. Plants which resist humidity well, or which are somewhat indifferent, have a high optimum. Those plants which suffer from humidity have two possible obstacles to growth, since their healthy condition is affected by excessive moisture as well as by excessive drought. For such plants as cucurbits, castor beans, and maize the optimum of humidity is not very high and their growth is checked to a considerable degree if the optimum is exceeded. Attention is here directed to a previous paper by the writer,[1] in which the capacity and duration of growth of different organs under the influence of varying

[1] Recherches sur le rôle physiologique de l'eau dans la végétation, Ann. sci. nat. Bot., ser. 7, 20 (1895); E. S. R., 7, p. 366.

humidity is discussed. It is there shown that flowering is retarded by dry soil or humid air and hastened by dry air and humid soil.

As regards increase in weight, the author's experiments show also that humidity, and especially excessive irrigation, is very harmful to plants intended for seed production. On wet soils the seeds are somewhat more numerous, but smaller and subject to rapid degeneration. Dryness of the soil in compelling the individual to grow slowly and by decreasing considerably the number of its descendants strengthens the species and protects it against external influences causing variation.

The same conclusions were reached relative to tubers. Excessive moisture weakens the race while apparently favoring the individual by increasing its growth. The tubers are heavier, but are less perfect than those which are produced under drier conditions.

PRACTICAL APPLICATIONS.

According to King,[1] after a rain, soil to a depth of a meter and a half, contains about 6,000 tons of water per hectare, the greater part of which is carried off by evaporation. Cultivation is very efficacious in preserving this water. Professor King determined on April 28 the quantity of water contained in two contiguous soils, afterwards plowing one of them. Seven days later the water content was examined to a depth of 1.2 meters. The plowed soil had lost from the upper 30 cm. 11 5 tons per hectare, and there was a gain of the same quantity of water for the succeeding 90 cm. The unplowed soil, on the contrary, to a depth of 1.2 meters, had lost 495 tons of water. Spring plowing, therefore, conserves the humidity necessary for plants, but although this plowing is very efficient, harrowing and scraping poorly done is not. Harrowing which simply scratches or furrows the surface without covering it completely with loose soil increases evaporation rather than reduces it. On the contrary, a layer of dry soil 2 cm. deep greatly reduces evaporation.

When a given soil produces vigorous plants whose transpiration is very active and young plants whose organs are less developed, the roots of the first will take up for themselves the humidity of the soil with greater force than those of the second. If the soil does not contain sufficient water for both, the weaker will suffer. This is the case with clover seeded with wheat in the autumn, which suffers in a dry spring, while clover seeded alone makes good growth. Farmers continue to sow their forage seed with cereals under the mistaken idea that the cereals are beneficial as a shade. If they would seed their forage plants alone, they would not only secure a greater yield but in dry countries they would stand a better chance of producing a crop.

This also explains certain facts relative to the irregular production of seed of the same kind of plants. The stronger plants take from the others the moisture and the fertilizers held in solution, and are thus

[1] Wisconsin Sta. Rpts. 1891, p. 100; 1893, p. 184 (E. S. R. 4, p. 122; 7, p. 565).

enabled to produce more perfect seed. This is also the case with trees in a field, which are well known to injure plants cultivated about them. Weeds injure cultivated plants in the same way. In view of these facts it would be interesting to investigate from a practical standpoint the effect on the total product of sowing crops together and cultivating one crop between the rows of another. An attempt should be made to determine by experiment the proportional reduction in the yield of one group of plants growing in the same soil with another, as, for example, legumes cultivated with cereals or between rows of potatoes.

Opinions are very diverse as to the cause of the efficiency of water employed in irrigation.[1] Some claim that the fertilizing action is due entirely to materials held in solution, and that water for irrigation should be turbid and impure, while others maintain that clear water produces the best results. It is known that the quantity of carbonic acid contained in water and its temperature modify the fertilizing action to a very great degree on different soils.

Prof. Ronna[2] has shown that upon clay soils abundant rains which thoroughly saturate and flood the soil may advantageously take the place of fertilizers. In dry seasons fertilizers remain without effect in the soil, and in most seasons no fertilizer is able to supply the fertilizing effect of rain. Water dissolves the elements of the soil which are necessary to the growth of plants. In well-manured, high, sandy soils the abundant spring rains wash out the soluble materials, such as nitrate of soda and guano. Pure water may be beneficial on some soils but injurious to others. Water charged with fertilizing elements is a valuable agent in fertility, but it must not be forgotten that on well-manured soil it may carry off more than it brings to the soil. This is the case when sewage waters are applied in excessive amounts. Voelcker has called attention to the presence of nitric acid in many waters suitable for irrigation. He insists on the necessity of studying the natural causes of loss through filtration of the fertilizing materials. In intensive cultivation the art consists in preserving the fertilizing materials as much as possible at the surface, where they provide for the needs of the plant at the beginning of its growth. Voelcker concludes that in order that irrigation with sewage water may be profitable on sandy meadows it will be necessary to employ about 20,000 cubic meters of water per hectare in 4 or 5 separate applications. Plants which grow rapidly make use of the fertilizers about them, but, on the other hand, cereals and truck crops are not able to receive large quantities of water throughout the entire year. Green plants produced by sewage water are not as nutritious as those grown on meadows irrigated with pure water.[3]

[1] On irrigation: A lecture by Prof. Voelcker (Jour. Roy. Agl. Soc. of England, 1867, p. 464).

[2] A. Ronna, Chimie appliquée à l'agriculture.

[3] Third report of the commission for inquiry into the best mode of distributing the sewage of towns, p. 48. London, 1865.

It is not a question of storing up fertilizing matter in the soil, but of rapidly disseminating it through the soil by means of the water. Experiments by Voelcker on the absorbent power of different soils on dilute solutions of ammonia, phosphates, and potash confirm this conclusion.

Ronna showed that meadows in England had been irrigated with water containing a large amount of lime with admirable results. It is only necessary to avoid such waters as come from peaty or marshy soils, since ordinarily they are charged with sulphate of iron.

It is not necessary for us, in a general dissertation, to go into details as to the quantity of water required for irrigating under each method of culture. The quantities vary according to the meteorological conditions of the regions under consideration. In the south of France about 16,000 cubic meters of water per hectare are required for 6 months' irrigation. Nevertheless, we are guided somewhat by experience, and give to the agriculturist as a basis the following general curve based upon the results of experiments:

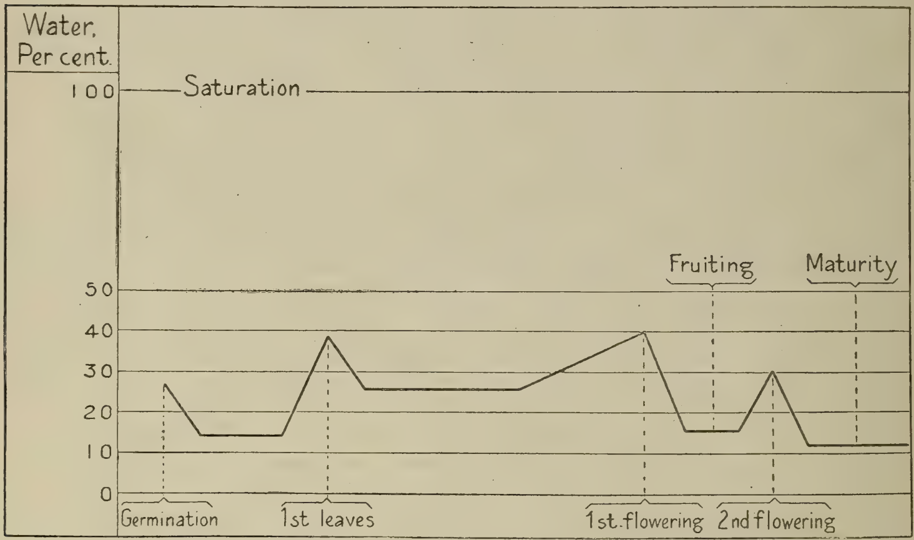

FIG. 1.—Diagram showing water requirements of plants at different stages of growth.

This curve is intended to indicate for plants of ordinary habits of growth the optimum amounts of water in the soil at different stages, the amounts being stated in percentages of saturation. It will be noted that the curve is characterized by a regular alternation of humidity and relative drought, as already explained.[1] From the point of view of legislation and coöperative societies for irrigation there is, at least in France, a serious difficulty in the use of this curve. The farmers

[1] The experimental basis upon which the curve rests has been discussed at length in a previous article by the writer, an abstract of which will be found in E. S. R., 7, p. 366.

necessarily have not the same soils to irrigate nor the same crops, and, consequently, there will be a serious complication in distributing the water, the demand for which is periodical and not constant. Nevertheless, to all those who are personally interested in proper irrigation the deductions from our theoretical investigation are commended. The application of these suggestions will certainly result in a much more valuable product.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Kjeldahl method and platinochlorids, C. VAN DAM (*Rec. Trav. Chim. Pays-Bas, 14 (1895), pp. 217–226; abs. in Jour. Chem. Soc., 1896, Mar., p. 218*).—The results of the author's investigations confirm those of others in showing that the Kjeldahl method fails to show the total amount of nitrogen present in certain platinochlorids, and that the error is not eliminated by prolonging the heating or by using Gunning's method. On platinochlorids of certain amins Wilfarth's method (addition of mercury) gave more satisfactory results. However, it failed to recover the total amount of nitrogen in ammonium platinochlorid. Both the platinochlorids of the amins and ammonium platinochlorids yield theoretical amounts of nitrogen when zinc dust is used in the digestion. Ethylamin aurochlorid and ethylamin mercurochlorid give good results by both Gunning's and Wilfarth's methods. "The author has demonstrated that the whole of the nitrogen is evolved as such when ammonium platinochlorid is heated with concentrated sulphuric acid for 5 hours."

The rapid determination of organic nitrogen, LÉONARD (*Rev. Chim. analyt. et appl., 3 (1895), p. 285; abs. in Chem. Ztg., 20 (1896), No. 4, Repert., p. 5*).—For the determination of nitrogen in milk and urine the author uses the following modification of the Kjeldahl method: To 10 cc. of the solution in a long-neck 300 cc. flask add 1 gm. each of water-free copper sulphate and disodium phosphate and 10 cc. of concentrated sulphuric acid. Heat the flask, inclosed in a sheet-copper covering, until its contents are clear and slightly green. When cool, wash into a 100 cc. flask, add an excess of alkali, and allow the copper precipitate to dissolve. Add 20 cc. of alkaline Rochelle salt solution and fill to the mark with water. Ammonia may be determined in an aliquot part by distillation in the usual way and by titration with sodium hypo-bromite.

The determination of nitrogen in Peruvian guano, HEIBER (*Landw. Vers. Stat., 46 (1895), pp. 407, 408*).—The author compared the Jodlbauer method with that proposed by E. Haselhoff[1] on 6 different

[1] Landw. Vers. Stat., 43 (1894), p. 289 (E. S. R., 6, p. 609). In this method the substance is extracted with water, the nitrogen being determined in the extract by Ulsch's method, in the residue by the Kjeldahl method.

kinds of guano. The former invariably gave higher results than the latter, the difference ranging from 0.14 to 3.11 per cent. It seems evident from these results that the guanin, urates, and similar nitrogenous substances in guano are not decomposed by the dilute sodium solution recommended for use in the distillation flask by Haselhoff.

The determination of nitrogen in guano, E. FRANKE (*Chem. Ztg., 20 (1896), No. 33, pp. 325, 326*).—Comparative tests of the Jodlbauer and Haselhoff extraction methods on 4 samples of Peruvian guano are reported. The percentages of nitrogen found were as follows:

Nitrogen in Peruvian guano.

	(1)	(2)	(3)	(4)
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Jodlbauer method	7.80	4.12	7.03	6.85
Haselhoff method	5.85	3.91	6.59	6.67

The conclusion was reached that the soluble organic nitrogen in the extract obtained in the Haselhoff method is not completely transformed to ammonia by the action of the soda solution.

The determination of nitrogen in guano, E. HASELHOFF (*Chem. Ztg., 20 (1896), No. 37, pp. 365, 366*).—The author states that the method proposed by him has given better results in his laboratory than the Jodlbauer method, and suggests that Franke's results were due to a departure from his method. He reports the results of comparative tests of the Jodlbauer and Haselhoff methods made at his request by Pfeiffer, which show a close agreement.

The determination of nitrogen in guano, E. FRANKE (*Chem. Ztg., 20 (1896), No. 43, p. 422*).—Replying to the criticisms of Haselhoff, the author claims that the organic nitrogen of Peruvian guano soluble in water is not completely decomposed by soda solution. With the Ulsch-Kjeldahl method, the ordinary Ulsch method, and the Ulsch method, using 75 cc. instead of 20 cc. of soda solution, the author found in a clear-water extract of guano 5.10, 3.30, and 3.84 per cent of nitrogen, respectively.

The works of Pfeiffer and Thurman[1] are referred to as confirming the author's conclusions.

An investigation upon the use of Wagner's citrate method for the determination of citrate-soluble phosphoric acid in ground Thomas slag, F. MACK and M. PASSON (*Ztschr. angew. Chem., 1896, No. 5, p. 129*).—One hundred cubic centimeters of the phosphoric-acid solution, obtained according to Wagner, is boiled in a 500 cc. flask, with 10 cc. of concentrated sulphuric acid and a drop of mercury, as in the Kjeldahl method for nitrogen, until the solution is colorless. After cooling the mercury is precipitated by a 10 per cent solution of sodium

[1] Landw. Vers. Stat., 46 (1895), pp. 1–20 (E. S. R., 7, p. 269).

chlorid and the whole made up to 200 cc. and filtered. Of the filtrate 100 cc. is taken, and when quite cold 100 cc. of ammonium-citrate solution and 25 cc. of magnesia mixture are added.

The authors claim great rapidity and accuracy. They give 28 comparative analyses with the molybdate method, none of which differs by more than 2 mg.—C. L. PARSONS.

The Stassfurt method of determining potash, A. ATTERBERG (*Chem. Ztg., 20 (1896), No. 15, p. 131*).—The method of potash determination recommended[1] by the Stassfurt Kali Works was compared with the ordinary Swedish method on 10 samples of potash salts containing from 12 to 16 per cent of potash. The Stassfurt method invariably gave higher results than the other, the difference amounting in some cases to 2 per cent, unless unusual care was exercised in washing with alcohol. When the final precipitate was repeatedly washed and then ground before transferring to the filter the results by the two methods were practically identical.

The determination of potash by the Stassfurt method, TIETJENS and APEL (*Chem. Ztg., 20 (1896), No. 21, pp. 202, 203*).—A reply to the above article by Atterberg maintaining that it is not shown that the high percentages of potash found by Atterberg in following the Stassfurt method were due to any inherent defect in the method. It is suggested that the impurity in the final salt may have been the fault of the analyst rather than of the method.

The determination of potash as potassium platinic chlorid, H. PRECHT (*Chem. Ztg., 20 (1896), No. 22, pp. 209, 210*).—In discussing Atterberg's criticism of the Stassfurt method (see above) the author states that it is customary for Swedish chemists to use 90 per cent alcohol for washing the final precipitate, while in the Stassfurt method 96 to 99 per cent alcohol is preferred, and points out that he called attention in 1879 to the same source of error as that noted by Atterberg.[2] He reports results of tests which indicate that the double salt of sodium is more soluble in the stronger than in the weaker alcohol, while the potassium salt is less soluble, one part of the latter being soluble in 42,600 parts of absolute alcohol, 37,300 parts of 96 per cent alcohol, and 26,400 parts of 90 per cent alcohol. It is claimed that the careful analyst can obtain accurate results with both 90 per cent and absolute alcohol, but for the above reasons the latter is to be preferred.

The decomposition of silicates by means of boric acid, P. JANNASCH and O. HEIDENREICH (*Ztschr. anorgan. Chem., 12 (1896), No. 3, pp. 208–222*).—One gram of the fine-ground silicate is carefully mixed in a platinum crucible of 60 to 65 cc. content with 3 to 4 times its weight of pure boric acid, or in case of refractory silicates 5 to 6 times, and with feldspar 8 times its weight. The mixture is then fused, special precautions being taken at the beginning to prevent material from being

[1] Ztschr. angew. Chem., 1895, p. 510.
[2] Ztschr. analyt. Chem., 1879, p. 509.

thrown out of the crucible. This operation requires from 20 to 30 minutes. The fusion is cooled and treated with 100 to 150 cc. of boiling water and 50 cc. of concentrated hydrochloric acid, the solution being kept near the boiling point until the mass is dissolved. The solution is evaporated to dryness on the water bath, and the boric acid removed by evaporating on a water bath at 75 to 80° C. with 2 to 4 successive portions of 60 to 75 cc. each of methyl chlorid, prepared as needed by saturating methyl alcohol in the cold with dry hydrochloric-acid gas.

Note on the distinction between boiled and unboiled milk, RUBNER (*Hyg. Rundschau, 5, No. 22; abs. in Ztschr. Fleisch- und Milchhyg., 6 (1896), No. 3, p. 52*).—The author states that the methods for distinguishing between heated or boiled and raw milk are not entirely reliable. Schreiner has claimed that boiled milk did not give off any hydrogen sulphid on heating, as fresh milk did; but the author did not notice the evolution of hydrogen sulphid in the case of many samples of normal milk. Likewise guajac tincture, which usually gives a blue color with raw milk, was not found reliable.

The author recommends the following test: Milk is shaken with more common salt than it will dissolve, heated to 30 to 40° C., and filtered. If coagulated albumen separates in the filtrate on heating, the conclusion is that the sample was boiled milk or a mixture of raw and boiled milk.

It is suggested that the change in milk by cooking, noticeable in the taste and smell, may be due to a breaking up of constituents, as in the case of the extractives of meat.

Rapid methods for butter examination, OSTERTAG (*Ztschr. Fleisch- und Milchhyg., 6 (1896), No. 2, pp. 72–76, figs. 2*).—The advantages of reliable rapid methods for testing the purity of butter are discussed, and the methods of Jahr and Bischoff are described in detail.

Jahr's method includes 3 tests, *i. e.*, heating (1) in a water bath at 50° C. with water; (2) with sulphuric acid, hydrochloric acid, and potassium-permanganate solution; or (3) with common salt solution, hydrochloric acid, and potassium-permanganate solution. Treated in either of these ways, pure butter, oleomargarine, and mixtures of the two give characteristic reactions, either in the appearance of the fat or coloring.

An apparatus for making the test is illustrated and described. As the quantities to be used of some of the reagents are stated in terms of the graduates furnished with the apparatus, no clear idea is furnished of the amounts actually used.

The Bischoff test depends upon the appearance of the sample when melted under specific conditions in an apparatus provided for that purpose, which is figured. The test is said to be used officially in Berlin, and by the veterinary police in the country.

The determination of small amounts of magnesia in limestone, HERZFELD and FÖRSTER (*Ztschr. Rübenz. Ind., 46 (1896), p. 285; abs. in Chem. Ztg., 20 (1896), No. 42, Repert., p. 154*).

A gas or saturated vapor thermo-regulator, H. PARENTY and R. BRICARD (*Compt. Rend., 122 (1896), No. 17, pp. 919–922*).

A new method of converting sulphates into chlorids, P. JANNASCH (*Ztschr. anorgan. Chem., 12 (1896), No. 3, pp. 223, 224*).—The sulphate is fused with boric anhydrid until fumes of sulphuric acid are no longer given off, the fusion being dissolved in hydrochloric acid.

On the composition of the red pigment of Amanita, A. B. GRIFFITHS (*Compt. Rend., 122 (1896), No. 23, p. 1342*).—The results of analysis indicate the formula $C_{19}H_{18}O_6$. The name Amanitin is proposed.

On a new reaction for asparagin, L. MOULIN (*Jour. Pharm. et Chim., ser. 3, 16 (1896), No. 11, p. 543*).

Detection and separation of the acid principles of plants, L. LINDET (*Compt. Rend., 122 (1896), No. 20, pp. 1135–1137*).

A new cooler, R. LASNE (*Ann. Chim. anal. appliq., 1896, p. 145; abs. in Chem. Ztg., 20 (1896), No. 42, Repert., p. 149, fig. 1*).

Device for maintaining constant level of liquids in receptacles, A. MATROT (*Jour. Pharm. et Chim., ser. 3, 16 (1896), No. 12, pp. 594, 595, fig. 1*).—A balanced T-tube connected with a water supply, one arm emptying into a waste pipe, the other into the receptacle. From the latter a float is suspended, from the former a weight. When water flows through the tube it will empty into the receptacle until the float rises and tilts the tube, when it will flow into the waste pipe, and *vice versa*.

A washing apparatus for the determination of nitric nitrogen according to Kühn, O. FÖRSTER (*Chem. Ztg., 20 (1896), No. 39, p. 383, fig. 1*).—A siphon-tube device for preventing alkali from being carried over in distillation.

Handbook for the biochemical laboratory, J. A. MANDEL (*New York: J. Wiley and Sons, 1896*).

Short introduction to the analysis of raw materials and manufactured products of agricultural and fat industries, W. KALMAN (*Kurze Anleitung zur chemischen Untersuchung von Rohstoffen und Producten der Landwirtschaftlichen Gewerbe und der Fettindustrie. Leipsic and Vienna: F. Deutick, 1896, pls. 3*).

Proceedings of the twelfth annual convention of the Association of Official Agricultural Chemists, H. W. WILEY (*U. S. Dept. Agr., Division of Chemistry Bul. 47, pp. 172, figs. 2*).—This is a detailed account of the proceedings of the convention held at Washington, September 5, 6, and 7, 1895. A brief account of this meeting has already been given in the Record (E. S. R., 7, p. 169).

Seventh report of the agricultural chemical experiment station at Tabor, Bohemia (*pp. 172, pls. 3*).

BOTANY.

On the action of different colors upon plants, C. FLAMMARION (*Bul. Min. Agr. France, 15 (1896), No. 2, pp. 273–277, fig. 1*).—The effect of growing various plants under red, green, blue, and clear glass has already been partially reported by the author,[1] but the results are given in greater detail in this bulletin. The following experiments were not referred to in the previous publication.

Maize was planted under the different-colored glass mentioned above, and the growth in height and weight per plant was, under white glass, 1.2 meters, weighing 111 gm.; under red glass, 0.6 meter, weight 7.5 gm.; under green glass, 0.25 meter, weight 3.5 gm.; while under blue glass there was no growth.

[1] Compt. Rend., 121 (1895), No. 25, p. 957 (E. S. R., 7, p. 746).

Rye grass was seeded November 13, under the same conditions, and the germinations began as follows: Under white glass December 5, red December 7, green December 8, blue December 15. All plants under the blue glass soon perished. The root development was noticed to be particularly affected by the different kinds of light, none developing under the blue glass, and but feebly under either the red or green.

In conclusion it is stated that "for plants from the seed the growth will be in the following order: White, red, green, blue. But the effect exerted after germination is in the order, red, green, white, and blue, or red, white, green, blue, depending on whether height or vegetative phenomena are considered."

It was further found that plants placed under bell jars colored with mono-chromatic solutions gave abnormally colored flowers, and that apples, peaches, cherries, strawberries, when placed under colored bell jars to ripen, remained blanched, and when mature were very watery and lacking in flavor.

Formation and assimilation of asparagin, O. LOEW (*Chem. Ztg., 20 (1896), No. 16, pp. 143–147; abs. in Jour. Roy. Micros. Soc., 1896, No. 3, p. 330*).—Asparagin is shown to be very often the result of splitting up of the proteids into asparagin and carbon dioxid. In other cases, as in the sugar of ripe beet roots, asparagin is a synthetic product and may be formed out of ammonia or nitric acid; this takes place in barley and maize. Sugar or some substitute is essential for the transformation of asparagin into proteids. This may take place in the dark and the sugar need not be formed in the same cells as the asparagin.

On the occurrence of nitrates in germinating plants, E. SCHULZE (*Ztschr. physiol. Chem., 22 (1896), No. 1, pp. 82–89*).—In 1885 the author published[1] an account of the presence of nitrate of potash in etiolated seedlings of *Cucurbita pepo*. In the experiments the seeds had been grown on sand, but when the sand had been thoroughly washed with distilled water there was a marked falling off in the nitrogen content of the seedlings. In 2 cases there was 0.614 per cent nitrate of potash in the dry matter of the seedlings, while in 2 others at the end of 2 weeks there was but a trace present. Experiments with *Lupinus luteus* seed gave similar results. When the cucurbit seed were grown upon gauze in distilled water there were no nitrates present in the seedlings at the expiration of 14 days, although glutamin and tyrosin were present. Negative results were obtained with seed of *Lupinus albus*, *L. angustifolius*, *Vicia sativa*, *Ricinus communis*, and *Zea mays*.

The author states that nitrates are not constantly present in seedlings, and that the claim of Belzung[2] that amids are supplied through the nitrates is incorrect.

Nitrogen assimilation in the cotton plant, C. E. COATES and W. R. DODSON (*Jour. Amer. Chem. Soc., 18 (1896), No. 5, pp. 425–428*).—A

[1] Jour. prakt. Chem., 32 (1885), p. 451.

[2] Ann. sci. nat. Bot., ser. 7, 15 (1892), p. 249.

series of pot experiments was undertaken to test the possibility of the assimilation of free nitrogen by the cotton plant. To 2 pots no nutrient solution was added, the plants growing in the sterilized sand. To the others a nutrient solution of potassium phosphate, magnesium sulphate, potassium chlorid, and calcium chlorid was added. To some of the pots an infusion of soil from a cotton field was added. The amount of nitrogen gained, either with or without soil inoculation, was so small as to fall within the limits of error of the experiments, and while the results obtained were wholly negative, yet the authors think the non-assimilation of free nitrogen by the cotton plant is not proved.

The essentials of botany, C. E. BESSEY (*New York: Henry Holt & Co., 1896, pp. VII, 356, figs. 225*).—To all those acquainted with former editions of this useful work, the present revised and enlarged edition will be very welcome. A commendably simple and direct treatment is adopted, and technical terms are employed only where their use would seem to make the text plainer. The advance of our knowledge relating to the protoplasm and the plant cell have required the rewriting of the chapters devoted to those subjects. The same applies to the chapter on plant physiology.

The author, agreeing with Debary and others, excludes the slime molds from the plant kingdom, but for the benefit of those disposed to retain them they are considered in an appendix to the protophytes. Pandorina and Volvox also seem to be considered as probably outside the plant world. The terms anthophyta, spermatophyta, phanerogams, etc., are used in such a way as to show their proper restrictions and uses.

The systematic arrangement of the angiosperms offers some novelties that will require the test of time to be accepted or rejected by systematists.

Useful Australian plants, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 5, pp. 259–262, pls. 2*).—Woolly-butt (*Eucalyptus longifolia*) and tufted hair grass (*Deschampsia cæspitosa*) are illustrated and described, with notes on commercial value.

Australian fungi, D. MCALPINE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 5, pp. 299–307, pls. 2*).

Experimental investigation of paratonic curving of firs, J. WEISNER (*Ber. deut. Bot. Ges., 14 (1896), No. 5, pp. 180–185*).—The author discusses the curving during growth due to external influences as opposed to that caused spontaneously.

The rôle of anatomy in distinguishing critical species, P. PARMENTIER (*Ann. sci. nat. Bot., ser. 8, 2 (1896), No. 1–3, pp. 1–36*).

Contributions to the comparative anatomy of the Caprifoliaceæ, LINSBAUER (*Verhandl. zoolog.-bot. Ges. Wien, 1895, p. 43; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, p. 140*).

Comparative histological studies of the wood of the Pomaceæ, A. BURGERSTEIN (*Sitzungsber. Acad. wissench. Math. naturw. classe, 104 (1895), I, pp. 723–772; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 128, 129*).

Investigations on the embryo sac of fleshy plants, E. D'HUBERT (*Ann. sci. nat. Bot., ser. 8, 2 (1896), No. 1–3, pp. 37–128, pls. 3*).

Observations on the structure of Cystopus candidus, H. T. WAGER (*Internat. Jour. Micros. and Nat. Sci., 6 (1896), No. 31, pp. 225–227*).

Concerning the anatomical structure and ash of leaves of Phytolaccaceæ and their relation to systematic arrangement, C. SCHULZE (*Inaug. Diss. Erlangen, 1895, pp. 56, pl. 1; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 133, 134*).

The form of the leaves of sugar beets and some of their transformations, R. KNEIFEL (*Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1895, p. 965; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 135, 136*).

Sexual reproduction in plants, M. MOBIUS (*Biol. Centbl., 16 (1896), pp. 129–153, figs. 10; abs. in Jour. Roy. Micros. Soc., 1896, No. 3, p. 328*).—The absence of sexuality in many groups of plants is commented upon and sexual reproduction is regarded as having a twofold function, the maintenance of stability by the elimination of acquired characteristics and the production of new varieties and species by the union of different germ plasms. The crossing of species is held to be more common than is generally believed.

A contribution to the knowledge of germination, D. PRIANISCHNIKOW (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 459–470*).

A contribution to the biology of variegated leaves, E. STAHL (*Ann. Jard. Bot. Buitenzorg, 13, pp. 137–216, pls. 2; abs. in Bot. Ztg., 54 (1896), No. 14, pp. 209–215*).

Honeydew, J. VAN DER PLANK and M. P. BIOURGE (*La Cellule, 9 (1896), pp. 375–399; abs. in Jour. Roy. Micros. Soc., 1896, No. 3, p. 321*).—The authors collected some of the exudation from the copper beech and found it was composed of a mixture of gum, dextrin, and levulose. When incinerated it gave 1.55 per cent ash composed of CaO, MgO, and K_2CO_3.

Concerning the presence of arganin in the roots and tubers of certain plants, E. SCHULZE (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 451–458*).

On the presence of pectic substances in the epidermal cells of the roots of Equisetum, L. VIDAL (*Jour. Bot. France, 10 (1896), No. 14, pp. 236–239, figs. 2*).

A contribution to the knowledge of lignified cell membranes, H. C. SCHELLENBERG (*Inaug. Diss. Zurich, 1895, pp. 36; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 115, 116*).

Researches on the intervention of atmospheric ammonia in the nutrition of plants, A. MÜNTZ (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 2, pp. 161–214, figs. 5*).

On the presence in Monotropa hypopithys of a glucosid of methylsalicylic ether and on the hydrolyzing ferment of this glucosid, E. BOURQUELOT (*Compt., Rend., 122 (1896), No. 18, pp. 1002–1004; Rev. Sci., ser. 4, 5 (1896), No. 20, p. 629*).

Assimilation of nitrogen by fungi, K. PURIEWITSCH (*Ber. deut. bot. Ges., 13 (1895), No. 8, pp. 342–345; abs. in Jour. Roy. Micros. Soc., 1896, No. 3, p. 334*).—Experiments were conducted with *Aspergillus niger* and *Penicillium glaucum* and the author concludes that they can absorb nitrogen from the air only when there is present in the nutrient solution a sufficient amount of sugar.

A contribution to the nitrogen question, J. H. AEBY (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 409–439*).

METEOROLOGY.

The work of the station of agricultural climatology of Juvisy, France, in 1895, C. FLAMMARION (*Bul. Min. Agr. France, 50 (1896), No. 2, pp. 257–284, fig. 1*).—The observations of this station are summarized with reference to the action of solar radiation on the atmosphere, the soil, and the plant. A record for 18 years (1878–'95) shows the greatest solar activity in 1893. A close correspondence is shown between the curves representing the occurrence of sun spots and the mean annual temperature for the period from 1879 to 1895. The temperature (—16° C.) in February was the lowest observed since 1740. While February was excessively cold, September was excessively hot, reaching the maximum for the year (33.7° C., September 7). Such a temperature for this month has not been observed since the invention of the thermometer, the average for the month (19.1° C.) being 3

degrees above the normal. The period from May to July was excessively wet, from August to October excessively dry, the rainfall being 92 mm. in June and 0 in September. In fact there was no rainfall from August 14 to the last of September. The report on observations on the temperature and water of the soil are noted (p. 36). Observations with different forms of actinometers are reported. Reducing the results obtained with the distillation actinometer by means of Houdaille's formula, it was found that the number of calories registered during 1895 was 144,411. A general correspondence between the temperature of the air, hours of sunshine, and calories is traced in a diagram.

An account is given of observations on the period of growth, sums of temperature, and hours of sunshine, and calories of heat received during different parts of the period of growth are reported for sweet corn seeded at 3 different dates and at different distances.

The influence of color on the quantity of heat absorbed was tested by means of thermometers with cylindrical and spherical bulbs in black, white, and different-colored wooden cases, and by observing the heat transmitted by red, green, blue, and white glass. The heat absorbed increased with the depth of color, the order being on August 22, black 67° C., indigo 66.8°, violet 66.5°, blue 66.3°, green 65.5°, red 60°, orange 59.5°, white (dull) 58°, and white (shiny) 50°. The amount of heat transmitted by the different-colored glass decreased as the extreme right of the spectrum was approached, the order being white, red, green, blue.

A soil artificially blackened showed a temperature 10° higher at a depth of 0.5 meter than a light soil under the same conditions. Soils, therefore, store up heat somewhat in proportion to their depth of color, and the same may apply to plants. The green blade of corn, for example, when exposed to the sun may attain a higher temperature than an uncolored thermometer placed under the same conditions.

Chapters are given on the action of different rays of the solar spectrum on vegetation, the internal temperature of trees, the transpiration of plants, the action of electricity on plants, and various other experiments on plants.

The determination of the relative quantities of aqueous vapor in the atmosphere by means of the absorption lines of the spectrum, L. E. JEWELL (*U. S. Dept. Agr., Weather Bureau Bul. 16, pp. 12, fig. 1*).—This is a report of observations on "the rain-band" during the period from January 16, 1892, to January 31, 1893.

"The method of observation used was to estimate the intensity of a water-vapor line in terms of the solar line most nearly equal to it in intensity, and in close enough proximity to render the comparison easy and sufficiently exact. One observation generally included several comparisons. . . .

"Having selected a series of comparison lines, it became necessary to determine the relative intensities of both the solar and the water-vapor lines used in the comparisons, in order that the observations might be available for actual measurements

of intensity and might mean something really definite instead of mere guesswork. For this purpose a photographic scale was constructed, consisting of a series of lines regularly increasing in intensity from a line barely visible to others as strong as were desired.

"A large, narrow slit was used, with a gaslight behind it and a plate of ground glass between them to produce a more even light. A series of images of the slit was then made upon a photographic plate held in a camera, the lens of which had been covered with a piece of wire gauze fine enough to produce a shading to the edge of the lines and a somewhat diffuse appearance of the lines themselves, but not sufficiently fine to produce any definite side lines due to diffraction fringes.

"In the scale thus constructed the exposures were so timed as to be in geometrical ratio, the object being to form a scale of lines whose intensity should vary, as the geometrical series 1, 2, 4, 8, 16, etc. These lines formed the principal divisions, while, to facilitate measurements, an intermediate line was added by making the ratio of the series 1.414 or $\sqrt{2}$."

The author concludes from the results of his observations that this method may be of great value in studying the distribution of water vapor in the atmosphere, but that it is of little use for regular observations upon which to base weather forecasts.

The diurnal lunar waves and the secular variations of the barometer, P. GARRIGON-LAGRANGE (*Compt. Rend.*, *122* (*1896*), *No. 15*, *pp. 846–849*).—The author concludes from his investigations that the action of the moon on the atmosphere is very marked, amounting on the 10th parallel to 1.2 mm. of mercury. This action may be attributed to the law of universal attraction, and appears to manifest itself not only in daily and semidaily oscillations, as in the case of tides, but is also exerted through monthly, annual, and secular periods.

North Carolina weather during the year 1895, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina State Weather Service Rpt. 1895*, *pp. I–L*, *1–264*, *maps 26*).—This report includes lists of publications of the State Weather Service during 1895, lists of meteorological stations and observers and crop correspondents, notes on the distribution of forecasts in the State, and a meteorological summary for the year as compared with previous years (1882–'94), with general remarks on the climate of North Carolina and on the weather and crop conditions during 1895, and charts of normal annual temperature and precipitation for the State. Meteorological bulletins issued during the year are published as an appendix.

The annual summary is as follows:

Temperature (degrees F.).—Mean, 57.4; normal, 59; departure, —1.6; maximum, 104, June 2 and 3, and September 22 and 23; mean maximum, 67.6; minimum, —18, January 13; mean minimum, 47.4; mean monthly range, 51; mean daily range, 20.2; absolute range, 122. *Pressure* (inches).—Mean, 30.09; normal, 30.08; departure, +0.01; maximum, 30.77, December 17; minimum, 29.28, February 7; absolute range, 1.49. *Relative humidity*.—Normal (per cent), 74.6. *Precipitation* (inches).—Average, 50.23; normal, 53.29; departure, —3.06; greatest monthly, 14.84; least monthly, 0.05. *Wind*.—Prevailing direction, SW.; average direction for many years, SW.; maximum velocity (miles per hour), 66. *Weather*.—Number of clear days, 160; number of cloudy days, 98; number of rainy days, 108; number of partly cloudy days, 107.

"The meteorological conditions prevailing during the year 1895 present several features of unusual interest. The winter months were exceptionally severe, and minimum temperatures occurred in the mountainous sections of the State lower than any previously recorded. The mean temperature for February is the lowest for any month of any year since 1872, excepting only January, 1893, which was 1.9 degrees colder.

"During the summer there were two periods of unusual heat, one extending from May 29 to June 6; the other from September 18 to September 26, during both of which maximum temperatures (above 100 at many places) occurred, breaking all previous records at those seasons of the year. Nevertheless, the cold of winter kept the annual mean temperature for the State below the normal.

"Following a period of excess of rainfall (March, April, May), the 7 months from June to December were notable for the continued prevalence of droughty conditions, all 7 months being below the normal in rainfall, and September particularly so. Yet the annual deficiency was not very great. Since 1872 there have been 7 years with a less annual total of rainfall than 1895; while this year there were no months so dry as December, 1889, November, 1890, and October, 1892. There has probably never before occurred so extended a period of deficiency in precipitation."

Meteorological observations in Wyoming, 1891–'96, J. D. CONLEY (*Wyoming Sta. Bul. 27, pp. 44*).—General notes are given on the weather of Wyoming, and on the character and history of the meteorological observations made by the station since 1891, with descriptions of apparatus and summaries of observations at the station at Laramie, and at the substations at Lander, Saratoga, Sheridan, Sundance, and Wheatland.

The general summary for 1895 is as follows:

Temperature (degrees F.).—Highest—Laramie, 87, July 27; Lander, 89, July 26; Sheridan, 95, August 15; Sundance, 94, July 22 and 23; Wheatland, 101, July 27; lowest—Laramie, —30, February 12; Lander, —26, February 11; Sheridan, —38, February 7; Sundance, —31, February 7; Saratoga, —35, February 11; highest monthly range—Laramie, 31.5, for September; Lander, 31.5, June; Sheridan, 35.4, October; Sundance, 25.4, October; Wheatland,[1] 35.1, October. Lowest monthly range—Laramie, 19, January; Lander, 19.6, April; Sheridan, 24.2, June;[2] Sundance, 16.6. December; Wheatland, 23.5, December. The highest annual mean temperature was at Lander, 42.1°; the lowest annual mean at Laramie, 38.5°. The average annual mean for the substations at Laramie, Lander, Sheridan, and Sundance was 40.7°.

Precipitation (inches).—The greatest annual was at Sundance, 23.84; the lowest annual at Laramie, 11.15; average for four substations (excluding Wheatland) and Dobin Springs and Little Horse Creek, 16.84.

The following additional observations were made at Laramie: *Terrestrial radiation:* Highest, 15.5°, November 27; lowest, 0°, April 5, 15, 26, June 3, October 4, November 17, 23, 25, and December 20.

Pressure (inches).—Highest, 23.388, September 28; lowest, 22.543, December 15; mean for the year, 23.049.

Wind.—Prevailing direction, Southwest; greatest number of miles traveled in one month, 12,047 (March); greatest number in one day, 547 (November 26).

Humidity.—Lowest relative, 15.7, April 25; mean relative for the year, 58.5.

Dew-point.—Highest, 54.5°, July 30; lowest, 15°; mean for the year, 23°.

Evaporation.—Greatest monthly, 7.294 in.; total for six months (April 17 to October 22), 37.02 in.

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[1] Eight months reported.

[2] The range was 24.3° in March.

The work of the Weather Bureau in connection with the rivers of the United States, W. L. MOORE (*U. S. Dept. Agr., Weather Bureau Bul. 17, pp. 106, figs. 3*).—The history of the work of the Weather Bureau in connection with the river floods and the value of the river and flood service are discussed, together with a list of special river stations; an explanation of the system of flood warnings; tables of distances, river tributaries, and rate of flood movement; and reports by officials in charge of river stations at Montgomery, Alabama; Fort Smith and Little Rock, Arkansas; Redbluff and Sacramento, California; Augusta and Atlanta, Georgia; Cairo, Illinois; Davenport, Dubuque, Keokuk, and Sioux City, Iowa; New Orleans, Louisiana; St. Paul, Minnesota; Vicksburg, Mississippi; Hannibal, Kansas City, and St. Louis, Missouri; Albany, New York; Raleigh, North Carolina; Cincinnati, Ohio; Portland, Oregon; Harrisburg, Pennsylvania; Charleston, South Carolina; Yankton, South Dakota; Chattanooga, Knoxville, Memphis, and Nashville, Tennessee, and Parkersburg, West Virginia.

"The special work of the Weather Bureau in connection with the rivers of the country is to facilitate commerce on navigable streams by publishing daily information as to water stages along the course of each river, and to issue timely warnings of floods so as to effect the saving of life and property.

"On January 1, 1896, the Weather Bureau river and flood system consisted of 135 special river stations, equipped with standard river gauges for measuring the vertical rise of the surface of the water, and in many cases with standard thermometers for measuring air temperature. These stations were manned by local observers receiving from the Weather Bureau pay commensurate with their services. There were 44 rainfall stations, equipped with rain gauges and manned by local paid observers, and so distributed in the various catchment basins of the tributaries to important rivers as to give, in connection with the regular meteorological Weather Bureau stations, a fair approximation to the average rainfall throughout each watershed. There were 38 completely equipped meteorological stations of the Weather Bureau where river measurements were made, and 22 Weather Bureau stations which were centers from which flood warnings and forecasts of expected changes in river level were issued."

Warnings against tornadoes, E. S. HOLDEN (*Iowa Weather and Crop Service, Monthly Review, 7 (1896), No. 5, p. 7*).—The author suggests surrounding towns on the southwest side at a distance from the town of about 2 miles by wire strung on poles and terminating in electric signal bells in houses, etc. Part of the circuit is composed of short stay wires which hold up vanes (6 x 4 in.) on the poles facing the dangerous quarter. These stay wires are so constructed that they will break when the wind blows at a rate of 60 miles per hour. The breaking of the wire sets the signal bells to ringing.

A prognostic of thunder, B. WOODD-SMITH (*Nature, 54 (1896), No. 1390, p. 151*).—It is claimed that the formation of a small group of parallel streaks of clouds, seldom more than 3 or 4 in number, definite in form, and limited in extent and duration, appearing either as white streaks on the blue, or more rarely as darker streaks against nimbus or cumulo-nimbus, is almost always followed by thunder within 24 hours.

Scientific kiteflying (*Science, 1896, May 29, p. 801; Nature, 54 (1896), No. 1390, p. 156; Monthly Weather Rev., 23 (1895), No. 11, pp. 418–420, figs. 9*).—"Instead of being flat and tapering at the lower end, the kites used are box-shaped, with their ends open and their sides partly covered with cloth or silk, and when fine piano wire is used instead of twine they are found to be splendid flyers. Recent ascents have reached altitudes of nearly a mile above sea level, and excellent results have been obtained by means of a self-recording instrument made by W. H. Fergusson, of the Blue Hill Observatory, which gives automatic readings of temperature, pressure, humidity, and wind velocity. Among the most important matters that have hitherto been noted is the presence of cold waves and warm waves at considerable elevations some hours before the temperature changes are noted at the earth's surface.

The prospect of improving weather forecasts by such means and by the use of small pilot balloons, which can be made at slight expense and can reach considerable altitudes, is considered to be very encouraging."

A practical treatise on weather forecasting, J. R. PLUMANDON (*Traité pratique de la Prévision du temps. Paris: G. Masson*).

Protection from lightning, A. MCADIE (*U. S. Dept. Agr., Weather Bureau Bul. 15, pp. 26, figs. 13*).—This is a revised edition of a previously issued circular upon the same subject (E. S. R., 6, p. 20).

Meteorological observations, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Met. Buls. 78, pp. 37–51, maps 2; 79, pp. 55–70, maps 2; 80, pp. 73–88, maps 2*).—The usual summaries of observations by the North Carolina Section of the Climate and Crop Service of the Weather Bureau of this Department for March, April, and May, 1896.

Report of the third annual meeting of the American Association of State Weather Services (*U. S. Dept. Agr., Weather Bureau Bul. 14, pp. 31*).—This consists of an account of the discussions and papers, officers of the association, and list of those in attendance at the meeting held in Brooklyn, New York, August 17, 1894.

WATER—SOILS.

The improvement of unproductive black soils, H. A. HUSTON (*Indiana Sta. Bul. 57, pp. 83–100, pls 4, figs. 5*).

Synopsis.—The unproductive areas of deep, black humus soils known as "bogus" lands occurring in central and northern Indiana, and which in many cases "were formerly marshes or the bottoms of old ponds," showed on chemical examination none of the characteristics usually assigned as the cause of unproductiveness. Experiments on 2 farms during 4 years indicate that the use of kainit and straw temporarily improved the drainage, and thus increased the productiveness of these soils. A system of drainage which taps the water-bearing gravel underlying the humus soil and lowers the water level to at least 40 in. by removing the cause of unproductiveness insures permanent improvement. Systems of drainage having this object in view are described.

"In nearly every county in central and northern Indiana may be found a kind of black soil, often known as 'bogus land.' It is also sometimes called 'alkali,' but not correctly, for the land has none of the real characteristics of alkali soil.

"The size of the areas of unproductive black lands varies from a few square rods to a hundred or more acres. Many of the places where it is found were formerly marshes or the bottoms of old ponds. Such land is found at all elevations above the level of the water courses from bottom lands beside the streams to the summit of the ridges or divides between the water courses."

"The unproductive soil itself consists of partially decomposed organic matter mixed with more or less sand and clay. In the large areas the organic matter makes up the greater part of the material and the soil has the general character of muck lands. In some of the smaller areas there is more mineral matter present. Often these small areas are low places in fields of clay or loam and differ from the remainder of the field only in having more black matter in the soil and being at a lower level. On digging down in these small areas it is generally found that the distance to the hard pan, clay, or gravel is much greater in the 'bogus' places than in the good soil near the border of the bogus place, indicating that at one time the 'bogus' place was filled with water to a considerable depth, and gradually became

filled up with the washings from the higher land surrounding it and with the products of the decay of the water plants growing in it.

"In the larger areas the stratification and general characteristics of muck beds are found, the muck being from a few inches to 15 ft. in depth."

Numerous samples of such soils were examined, but in no case was an acid reaction, metallic sulphids, or ferrous iron compounds found. "The waters of such soils have always given the slightly alkaline reaction common to the waters of this section."

Analyses of air-dry samples of soil and subsoil gave the following results:

Analyses of soil and subsoil of "bogus lands."

	Soil.	Subsoil.
	Per cent.	*Per cent.*
Water	16.320	16.230
Ash	39.940	42.870
Nitrogen	3.220	2.840
Phosphoric acid, P_2O_5	.460	.270
Potash, K_2O	.105	.108

The percentage of humus was abnormally high.

In some of the soils examined tile had been laid at the usual depth in the humus layer of soil without any improvement resulting, due to the fact that the pores and joints of the tile had been closed by the muck. Underlying the humus layer at a depth of 5 ft. or more was a bed of sand or gravel immediately overlaid by a thin bed of clay marl and carrying a strong flow of water. When holes were dug down to this layer, the water usually rose to within at least 30 in. of the surface.

"All the observations . . . lead to the conclusion that the real difficulty is the high permanent water level." Different systems of drainage which it is believed would be effective in lowering this level are explained in some detail. In most of these, where it is impossible to tap the water-bearing strata directly with tile, the main features are a series of permanent wells tapping the water-bearing strata and connected with tile at the depth to which it is desired to reduce the water table.

From one experiment on twentieth-acre plats of this soil, with straw, kainit (1 ton per acre), and lime (10,000 lbs.) singly and the last two combined, "it appears that the best yield [of corn] was obtained from the use of kainit, the next best from the use of kainit and lime, and the next best from the use of straw. . . . "

"In the years 1893, 1894, and 1895 no further materials were applied to the plats, but observations were continued on them. . . .

"All who have watched the progress of the experiments have agreed that the yields of the past 3 seasons on the treated plats have exceeded the yields of the first season. It therefore seems that one will be justified in calculating the returns on the yields of 1892. On this basis the application of a 3-inch layer of straw in 1892 has given a net increase of no less than 44 bu. of sound corn per acre for 4 years, or a total of 176 bu.

"The net returns from the use of 1 ton of kainit per acre are not less than 54 bu. per acre for 4 years, or a total of 216 bu."

On a second farm similar experiments were made with kainit and lime singly and combined, manure, and straw. One plat was subsoiled. The results were vitiated by injury from frost, but confirm in general those of the other experiments.

"The results of the field work show that there are satisfactory methods of temporary improvement—methods that are easily applied and that are exceedingly profitable from a commercial standpoint.

"While there is reason to believe that the effects of this temporary improvement may extend over a number of seasons, . . . permanent improvement of such lands must be effected by efficient drainage."

Soil temperature and water, C. FLAMMARION (*Bul. Min. Agr. France, 50 (1896), No. 2, pp. 262–268*).—This is a part of the report of the station of agricultural climatology at Juvisy, France. Observations on the temperature of the soil at the surface and at depths of 0.05, 0.10, 0.25, 0.50, and 1 meter are briefly summarized in tables and charts. In winter the highest temperature was observed at a depth of 1 meter, the lowest at a depth of 0.05 meter. A similar diurnal variation was also observed. In March and April the conditions were reversed, the soil being warmer at the surface than at a depth of 1 meter, and this remained the case until autumn. The average for the year shows that the temperature of the soil was lowest at 0.10 meter and increased up to 0.50 meter, where it was practically the same as at 1 meter.

The depth and temperature of the water in 2 drainage wells near together, one 13.56 meters deep and the other 14.08 meters deep, were observed. There was considerable variation in the temperature, depth, and chemical composition of the water in the 2 wells. The difference in temperature and depth was on an average 0.5° C. and about 1.5 meter, respectively. The temperature of the soil water was very uniform throughout the year at a depth of 14 meters, being but slightly affected by the weather, except during a very cold period in February.

Soil temperatures, J. D. CONLEY (*Wyoming Sta. Bul. 27, pp. 12, 19, 28*).—The soil thermometer used is described and a summary is given of observations at Laramie, Wyoming, since 1891 at depths of from 3 to 72 in.

In 1895 the mean temperature of the air was 37.9°, at 3 in. 43.7°, at 6 in. 44.4°, at 12 in. 44.2°, at 24 in. 44.5°, at 36 in. 44.5°, at 72 in. 45°. The following are the mean soil temperatures for the past four and a half years:

Mean soil temperatures from July 5, 1891, to December 31, 1895.

Period.	Depth.						
	Air.	3 in.	6 in.	12 in.	24 in.	36 in.	72 in.
	Deg. F.	*Deg. F.*	*Deg. F.*	*Deg. F.*	*Deg. F.*	*Deg. F.*	*Deg. F.*
1891 (from July 5)	....	44.6	48.5	49.8	50.4	48.6	51.7
1892	38.4	42.7	44.5	44.9	44.7	46.1	45.7
1893	40.8	43.1	45.3	45.1	44.8	45.0	45.3
1894	39.1	44.5	45.8	45.8	45.5	45.5	45.7
1895	37.9	43.7	44.4	44.2	44.5	44.5	45.0

The greatest difference between the readings of the 3-inch thermometer for 4 years (1892–'95) was 1.8°; for the 6-inch, 1.4°; the 12-inch, 1.6°; the 24-inch, 1°; the 36-inch, 1.6°; the 72-inch, 0.7°.

The public lands and their water supply, F. H. NEWELL (*U. S. Geological Survey Rpt. 1894–'95, pp. 463–533, pls. 5, figs. 10*).—This is an account of a continuation of work begun by the Geological Survey in 1879. The purpose of the present paper is "simply to point out the location of the public lands, to indicate in a general way their extent and position, and to lay before the public such facts as have been obtained concerning their broader physical characteristics, and their water supply. The latter is still a subject of investigation, and although considerable work relating to it has been done, in view of the enormous extent of country to be traversed it can hardly be said to be more than inaugurated."

The classification of the public land was provided for in the organic law of the Geological Survey approved March 3, 1879. The mapping and study of soil conditions have proceeded rapidly, and facts regarding the physical conditions of large portions of the national domain are now available. A detailed map is given showing the disposition made of public lands in the United States. Smaller maps are given which show the relative location of forests, woodlands, and irrigated areas, and the areas within which dry farming is attempted. The subject of water supply is treated under the general heads of sources of supply, including streams, wells, and reservoirs; and the supply of the individual States in the arid region.

Nitrates in potable waters, T. SCHLÖSSING (*Compt. Rend., 122 (1896), No. 19, pp. 1030–1038*).—The results of examinations of three sources of water supply with reference to nitric nitrogen and lime during the spring and summer of 1895 are reported in tables and diagrams. In one case the average amount of nitrogen found was 10.26 mg., of lime 114.2 mg. per liter; in the others the figures were 11.61 and 106.5 mg., and 10.84 and 86.3 mg., respectively.

Analyses of drinking water, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1894, pp. 84, 85*).—Analyses with reference to drinking quality of 12 samples of spring water, 16 of well water, and 9 of reservoir or brook water are reported.

FERTILIZERS.

A phosphate deposit in Juniata County, Pennsylvania, M. C. IHLSENG and M. S. MCDOWELL (*Pennsylvania Sta. Bul. 34, pp. 14, pl. 1, fig. 1*).—A preliminary report of investigation of the geology and chemical composition of a phosphate deposit in this locality to which the attention of the station was called in 1895.

"The existence of an especially fertile narrow belt of soil along the two central ridges of Juniata County has been known to observant farmers for years. It was in this fertile belt that the discovery was made, along the outcrop of what is called the Oriskany sandstone. Between this and the overlying Onondaga limestone is a decomposed mass of marls and sands in which the phosphatic material is found. The seams lie conformably with the stratification of the country, and may be easily traced. The prospect has not yet been developed, though trenches and drifts have been dug at numerous points along the contact, giving evidence of a persistent belt of phosphatic material which can be easily mined, is accessible to railroad, and incloses valuable material in amount sufficient to constitute an industry.

"Three classes of phosphatic materials have thus far been discovered. The first is a friable white rock, locally known as 'white vein,' containing in typical specimens from 29 to 54 per cent of bone phosphate. The second consists of red nodules similar in appearance to the so-called 'clay ironstones,' but containing from 45 to

52 per cent of bone phosphate, along with a considerable percentage of iron and alumina. The third class of material consists of blocks of what appears to be a dense blue limestone, but which appears on analysis to contain in the neighborhood of 40 per cent of bone phosphate of lime.

"These various materials were not of a grade equal to that of the southern product, but will nevertheless bear transportation to a moderate distance. None of the samples contained carbonic acid, and the material is otherwise of fair grade for fertilizer manufacture. The present indications are that the deposits are quite extensive. What renders the discovery of special interest and importance, however, is the fact that almost exactly similar geological conditions exist in many other parts of the State. Moreover, the reports of the State Geological Survey note the occurrence of 'calcareous nodules' in precisely these localities. Apparently there is warrant for the belief that further explorations may develop quite extensive phosphate deposits in various parts of the Commonwealth."

Analyses of commercial fertilizers, L. L. VAN SLYKE (*New York State Sta. Bul. 96, n. ser., pp. 445–489*).—Notes are given on the law and regulations governing the fertilizer control in New York State; the influence of different kinds of fertilizers upon plants; sources of nitrogen, phosphoric acid, and potash in fertilizers; terms used in analysis of fertilizers; and valuation of fertilizers, with tabulated analyses of samples of fertilizing materials collected during the fall of 1895.

"During the fall of 1895, there were collected 288 samples of commercial fertilizers, representing 182 different brands.

"Of these 182 different brands, 133 contained nitrogen varying in amount from 0.10 to 5 per cent. The average of all the guarantee analyses was 1.60 per cent of nitrogen, while the average amount found by the station analysis was 1.75 per cent.

"There were 181 brands which contained available phosphoric acid varying in amount from 5.56 to 16.81 per cent. The average amount of available phosphoric acid found by station analysis exceeded the average guarantee analysis by 0.85 per cent, the average of all the guarantee analyses being 9.12 per cent and the average actually found being 9.97 per cent.

"There were 153 brands which contained potash varying from 0.55 to 49.02 per cent. The average amount of potash found by our analysis exceeded the average guarantee analysis by 0.33 per cent, the average of all the guarantee analyses being 2.75 per cent, and the average actually found being 3.08 per cent. . . .

"Of the 182 different brands collected, 76 were below the manufacturer's guarantee analysis in one or more constituents, in amounts varying from 0.01 to 2.91 per cent.

"The amount of nitrogen was below the guarantee analysis of the manufacturer in 27 brands, the deficiency varying from 0.01 to 1.15 per cent and averaging 0.18 per cent. In 24 of the 27 brands the deficiency was not greater than 0.25 per cent; in 1 brand it was over 0.25 and below 0.50 per cent; in 1 brand it was over 0.50 and below 1 per cent; in 1 brand the deficiency was slightly over 1 per cent.

"The amount of phosphoric acid was below the manufacturer's guarantee analysis in 33 brands, the deficiency varying from 0.02 to 2.91 per cent and averaging 0.58 per cent. In 14 of the 33 brands the deficiency was less than 0.25 per cent; in 10 cases it was above 0.25 and below 0.50 per cent; in 2 brands it was above 0.50 and below 1 per cent; in 2 brands the deficiency was above 1 and below 2 per cent; in 3 brands it was above 2 and below 3 per cent.

"The amount of potash was below the manufacturer's guarantee analysis in 30 different brands, the deficiency varying from 0.01 to 1.55 per cent and averaging 0.43 per cent. In 14 of the 30 brands the deficiency was below 0.25 per cent; in 5 brands it was above 0.25 and below 0.50 per cent; in 7 brands it was above 0.50 and below 1 per cent; in 4 brands the deficiency was above 1 and below 2 per cent."

Comparative tests during 1893 and 1894 of sulphate of ammonia and nitrate of soda, H. GRAHL (*Jahrb. deut. landw. Ges., 10 (1895), pp. 482–487*).—A brief review is given of experiments by Märcker, which indicated that with small applications nitrate of soda and sulphate of ammonia were about equally effective but with larger applications the nitrate was superior to the sulphate; by Wagner, which indicated that the effectiveness of the nitrogen in sulphate of ammonia as compared with that in nitrate of soda was as 90:100; and by Schultz-Lupitz in the summer of 1890, which showed that the effectiveness of the nitrogen in both nitrate of soda and sulphate of ammonia was increased by the application of lime, the benefit being more marked in the case of the latter.

The experiments reported in this article were carried out on 12 tenare (119.6 sq. yds., or nearly ¼ acre) plats, to each of which were applied a basal fertilizer of 60 kg. (132 lbs.) of Thomas slag and 80 kg. (176 lbs.) of kainit. Two plats received in addition 20 kg. (44 lbs.) of nitrate of soda; 2 plats, 15 kg. (33 lbs.) of sulphate of ammonia; 2 plats, 200 kg. (440 lbs.) of lime in addition to 20 kg. of nitrate of soda; and 2 plats the same amount of lime in addition to 15 kg. of sulphate of ammonia; while 2 plats received lime without nitrogen. Crops of wheat and rye were raised on these plats during both 1893 and 1894.

The yields of grain and straw are tabulated in detail. The results in 1893 are too variable to admit of definite conclusions. Those obtained in 1894 indicate that the relation between the effectiveness of nitrogen in nitrate of soda and sulphate of ammonia is as 100:93 as regards production of grain and 100:95 as regards production of straw. The addition of lime increased the effectiveness of the nitrate of soda 8 per cent and the sulphate of ammonia 4½ per cent, so that in this case the relation between the effectiveness of the 2 forms of nitrogen was the same as that reported by Wagner, namely, 100:90.

Pot experiments with refuse lime from beet-sugar factories, G. FAYE (*Ugeskr. Landm., 41 (1896), p. 138*).—Experiments were made with oats grown in pots holding about 11 lbs. of soil. The soils used were different mixtures of (1) garden soil and washed sand; (2) garden soil and heavy clay; and (3) clay, sand, and refuse lime from beet-sugar factories. Three series of experiments with 9 or 10 pots in each were conducted. The addition of sand to the garden soil increased the yield of oats, the highest yield (at the rate of 12,944 lbs. of grain, roots, and straw per acre) being obtained with a mixture of 7 parts of sand and 3 parts of garden soil. The pots to which refuse lime was added showed a very marked increase in the yields obtained; the mixture of 3½ parts of clay, 3½ parts of sand, and 3 parts of lime yielded at the rate of 13,895 lbs. of total crop per acre (4,520 lbs. of grain and 9,375 lbs. of roots and straw), against a total yield of 5,673 lbs. (1,153 lbs. of grain and 4,520 lbs. of roots and straw) from a mixture of 4¾ parts clay, 4¾ parts sand, and ½ part of refuse lime.—F. W. WOLL.

Fertilizer problems, P. WAGNER (*Düngungsfragen. Berlin: Paul Parey, 1896, Nos. 1, pp. 40; 2, pp. 39, figs. 6; 3, pp. 56, figs. 18*).—This is a third revised edition of part 1 and a second edition of part 3. Part 1 contains the following articles: Is it rational to fertilize with ground Belgian phosphate? Can the purchase of prepared phosphate meal be recommended? Is there a cheap mineral phosphate which can be used with profit as a substitute for Thomas slag? How can the farmer protect himself against adulterated Thomas slag? Is there an easily soluble and a difficultly soluble Thomas slag? What kind of guaranty should a farmer demand in order to protect himself from low-grade Thomas slag and other phosphates? On what principle should the trade in Thomas slag be regulated? Will it be commercially profitable to produce an easily soluble and quick-acting Thomas slag? Under what conditions will fertilizing with Thomas slag be most profitable and under what conditions will the use of superphosphate be preferable? What precautions must be observed in field experiments with phosphates in order to avoid false conclusions?

Part 2 contains the following articles: What crops increase the nitrogen supply of the farm? What plants are adapted to the purposes of green manuring? Is it true that liberal fertilizing with potash and phosphoric acid increases the nitrogen assimilation of leguminous plants? Is it true that green manuring on the better class of soils is an agricultural error? Under what conditions is green manuring rational and under what conditions is it to be considered a mistake? What are the secondary influences of the practice of green manuring?

Part 3 contains the following articles: What do field experiments with fertilizers teach? Results of field experiments with fertilizers at the Darmstadt station on barley, oats, and potatoes. How much phosphoric acid and potash should be applied to different plants? How much nitrogen should be applied to wheat, oats, barley, rye, clovers and other leguminous plants, carrots, beets, cabbages, potatoes, corn, and tobacco? How must Thomas slag be prepared in order to be quick and sure in its action?

Fertilizer for plants, C. H. THOMPSON (*Ztschr. angew. Chem., 1896, No. 10, p. 299*).—A patented process in which a mixture of 4.5 kg. soot, 7.2 kg. fine ground bone, and 7.2 kg. gypsum is boiled in 225 liters of water containing 240 gm. of phosphoric acid and absorbed in peat or moss.

The influence of carbon bisulphid on the growth of plants, MACH (*L'Engrais, 11 (1896), No. 23, p. 543*).—Applications of 200 gm. per square meter increased the yield of oats, corn, potatoes, and beets to a marked degree.

The use of sewage water on meadows in Alsace (*Jour. Landw., 44 (1896), No. 2, pp. 195–200*).

Note on the deposits of guano in Peru, D. CRISPO (*L'Engrais, 11 (1896), No. 22, pp. 517, 518*).

Potassic fertilizers, G. SMETS and C. SCHREIBER (*L'Engrais, 11 (1896), No. 22, pp. 516, 517*).

Superphosphate-gypsum, T. PFEIFFER (*Deut. landw. Presse, 23 (1896), No. 48, p. 425*).

Commercial fertilizers H. A. HUSTON and W. J. JONES (*Purdue University Special Bul., May, 1896, pp. 8*).—Brief notes on the extent of the fertilizer trade in Indiana and on the quality of fertilizers sold in that State, explanation of terms, and tabulated analyses and valuations of 378 samples of fertilizers.

Analyses of commercial fertilizers (*Kentucky Sta. Bul. 60, pp. 133–142*).—Tabulated analyses and valuations of 63 samples of fertilizers, with explanatory notes.

Inspection of fertilizers in Maine in 1896, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Bul. 25, pp. 17*).—Analyses of 76 samples of fertilizers furnished by the manufacturers or dealers in compliance with the State law.

Fertilizer analyses, H. B. BATTLE (*North Carolina Sta. Buls. 37, pp. 21; 38, pp. 3*).—The usual notes and explanations, and tabulated analyses and valuations of 279 samples of fertilizers.

Analyses of fertilizers, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1894, pp. 82–84*).—Analyses are reported of 15 samples of wood ashes, 2 of limekiln ashes, 1 of refuse tannery salt, 1 of refuse from soap works, 2 of granite dust, 2 of guano, and 6 of muck.

FIELD CROPS.

Cotton culture, R. J. REDDING (*Georgia Sta. Bul. 31, pp. 389–417*).

Synopsis.—As a result of experiments at the station, King Improved variety, a distance of 1 by 4 ft., 400 lbs. of a complete fertilizer per acre, applying two-thirds of the fertilizer before planting and one-third with the seed, superphosphate instead of Tennessee soft phosphate, and leaving the cotton without topping, are recommended.

This is a continuation of work published in Bulletin 27 of the station (E. S. R., 6, p. 884).

Test of varieties (pp. 391–397).—Eighteen varieties were tested. The yield at each picking, number of bolls to the pound of seed cotton, number of seeds in 1 lb., yield of lint and seed, percentage of lint, and total value of lint and seed are tabulated. The largest yield of lint (511 lbs. per acre) was made by King Improved, which stood fourth in the yield of seed cotton and seed, thirteenth in size of boll, and second in earliness. In a comparative trial of Jones Improved and King Improved, the latter yielded 1,759 lbs. of seed cotton per acre, surpassing Jones Improved by 108 lbs., and in money value of yield by $6.27 per acre.

Distance experiments (pp. 397–402).—In rows 4 ft. apart single stalks were left at distances of 1, 2, 3, and 4 ft. During this and the 4 previous years, on the manured and unmanured plats, the largest yield was made on the plats planted at distances of 1 by 4 ft.

The following table gives the yield of seed cotton for different distances for each year of experiment:

Yield of seed cotton at different distances.

	4 by 1 ft.	4 by 2 ft.	4 by 3 ft.	4 by 4 ft.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1891	1,943	2,027	2,007	1,833
1892	1,616	1,516	1,501	1,439
1893	1,903	1,905	1,925	1,770
1894	2,065	1,812	1,843	1,671
1895	2,270	2,047	1,985	1,767
Averages of 5 years	1,960	1,861	1,852	1,696

In an experiment on the distance between rows, with a uniform number of plants per acre, the largest yield was from the 2-foot rows.

Effect of increasing amount of fertilizers (pp. 402–405).—In this experiment a complete fertilizer was applied at the rate of 400, 800, and 1,200 lbs. per acre and the results compared with those obtained on check plats. With the variety King Improved a profit of 189 per cent was

made when 400 lbs. of fertilizer was used, and with the Jones Improved 69 per cent; where 800 lbs. was applied the gain fell to 13 and 26 per cent, respectively; and with 1,200 lbs. there was a gain of 15 per cent and a loss of 33 per cent, respectively.

Applying fertilizers in the drill (pp. 405, 406).—In different cases fertilizers were applied (1) all before planting, and (2) two thirds before planting and one-third with the seed; the results favored the latter course.

Tennessee soft phosphate vs. acid phosphate (pp. 407, 408).—Superphosphate in a complete fertilizer was compared with 1, 1½, and 2 times the same amount of Tennessee soft phosphate. The latter was applied in each case at a loss.

Effect of topping cotton (pp. 408, 409).—Single rows were topped July 1 and 15 and August 1 and 15; others were not topped. The author concludes that the topping proved a decided injury.

General fertilizer experiments (pp. 410–416).—In 1895 the formula giving best results was 468 lbs. of acid phosphate, 36 lbs. of muriate of potash, and 286 lbs. of cotton-seed meal (or nitrate of soda 130 lbs.); the mixture contained 8.77 per cent of available phosphoric acid, 2.54 per cent of potash, and 2.54 per cent of nitrogen.

Cowpea, W. C. STUBBS, W. R. DODSON, and M. BIRD (*Louisiana Stas. Bul. 40, 2d ser., pp. 1439–1468*).—This is mainly a popular bulletin, partly compiled, on the cowpea.

In an experiment to determine whether the present varieties had been produced by cross-fertilization 78 plants were selected, including 24 varieties. When the flower buds were formed each plant was surrounded by a wooden frame. One-half of these were covered with mosquito netting and the remainder with thin muslin. Pollen was dusted by hand on the stigmas of 12 plants covered with netting, but no difference in results was observed. Over 95 per cent of the protected flowers matured seed, showing that the flowers are self-fertilizing. Close observations failed to detect any cross-fertilization by insects. Flowers fertilized artificially failed to produce seed.

From a study of 63 varieties the authors conclude as follows:

"It would seem, then, that as far as we can tell 1 original form of the cowpea was selected for cultivation, and in the natural tendency to vary from that original form under new environments some forms would arise exhibiting new characters. These individuals were selected and preserved, the new characters tending to become more permanent. The offspring of these would often tend to revert, and other variations arising would keep in existence many of the connecting links between the original and the new forms.

"Many of the so-called varieties of the cowpea are forms of these connecting links. All forms studied by me can not claim to be more than 1 species, *Vigna sinensis*, with the possible establishment of a small number of varieties."

During 3 years a green-manuring experiment was conducted at the station with 12 varieties of the cowpea on 12 plats, 9 by 9 ft. The seed of each variety was sown at the rate of 2 bu. per acre. On one-

half of each plat the vines and roots were removed when the crop was ripe; on the other half they were plowed under. In the spring and fall of each year a sample of soil from each half plat was analyzed for nitrogen, phosphoric acid, and potash. Tabulated data are given containing analyses (fertilizer constituents) of different parts of the plant and analyses of the soil of the plats.

The largest amounts of fertilizing ingredients were found in the soil of the plats on which the varieties Black, Unknown, Indian, Red Pepper, and Clay were plowed under, showing an estimated gain for 3 years of 190 lbs. per acre for the soil from which the crop had been removed and 395 lbs. per acre for the green-manured soil.

The results of experiments are summarized in part as follows:

"The best varieties of peas for vines and green manuring are the Unknown, Black, Clay, Red, etc., while the strictly bunch varieties, Whippoorwill, Blue, Black-eye, etc., give larger returns in peas.

"Cowpea vines can be converted into hay or preserved as silage, both of which have proven by repeated experiments to be palatable and nutritious food for farm stock."

On account of its capacity for gathering nitrogen the cowpea is regarded as a valuable crop in a rotation for the South. A 3 years' rotation with 5 crops (oats, cowpeas, cotton, and corn and cowpeas), with suitable fertilizer for each crop, has been found most effective in building up worn soils. The vines should, if possible, be converted into hay or silage and fed to stock. If they can not be thus utilized, they should be plowed under for green manure.

On the ground of economy it is recommended to plow under the green manure early in the fall and sow the ground later in some winter crop, like rye, to be turned under later if a spring crop be desired.

Miscellaneous fodder crops, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 167, 168*).—The yield and composition with reference to both food and fertilizer ingredients are given for the following crops grown experimentally at the station: Soja bean, hairy vetch, hairy vetch and oats, spring vetch, spring vetch and oats, and serradella.

"[Soja beans, green and black medium varieties] were grown in 1893, as well as in 1894, and proved satisfactory each year. . . . No other leguminous hoed crop which we have grown has given us better returns in tonnage of green fodder, dry matter, or protein. The green variety this year yielded at the rate of 6½ tons green fodder, 2 tons dry fodder, and nearly a quarter of a ton of protein to the acre. The crop was poorer in protein than last year's growth. . . . Although good growths were made [of hairy and spring vetches with and without oats] our experience with these crops for several years does not lead us to consider them equal to peas and oats. . . . [Serradella yielded] about a ton of dry matter to the acre. . . . We recommend it as a promising forage crop."

Experiments with oats, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 54, pp. 115–125*).

Synopsis.—Spring plowing, early sowing, hot-water treatment for smut, heavy seed, the shoe drill with press wheels, and cutting when ripe are recommended.

This is a continuation of work published in Bulletin 42 of the station (E. S. R., 5, p. 1072). Tabulated data are given for each set of experiments.

Method of preparing land (pp. 116–118).—Fall plowing, spring plowing, and disking the land were compared; also cultivating the seed in *vs.* drilling. "The spring-plowed land on which the seed was drilled in gave the best results in nearly every instance."

Time of seeding (pp. 118, 119).—This experiment occupied 45 plats. Oats were sown March 1, 8, 15, 22, 29, April 5, 12, and 26. The yield decreased as the date of sowing became later.

Hot-water treatment for smut (pp. 119, 120).—This treatment has also been described in Bulletin 29 of the station (E. S. R., 3, p. 789). "The average for the 5 years shows a gain of 2 bu. to the acre in favor of the treatment."

Light, medium, and heavy seed (pp. 120, 121).—The averages for the 6 years give a yield of 28.48 bu. for light seed, 29.85 bu. for medium, and 30.76 for heavy seed.

Methods of seeding (pp. 121, 122).—As the average of 5 years' trials broadcasting yielded 26.18 bu. per acre, seeding with the hoe drill 25.71, seeding with the shoe drill with press wheels 30.31, and seeding with the shoe drill without press wheels 28.72 bu.

Amounts of seed (pp. 122, 123).—In 1894 and 1895, 1½ to 2½ bu. gave the largest yields; in the 3 years previous, 4 bu. gave the largest returns.

Time of harvesting (p. 123).—In 1894 oats cut in the dough yielded 17.85 bu., cut in the hard dough 21.08, and cut when ripe 26.37 bu.

Varieties (pp. 123, 124).—The following have given the largest average yields for 5 years: Northwestern White, Belgian, Pedigree Red Rust Proof, Board of Trade, Golden Sheaf, and Brown Winter.

The assimilation of fertilizing materials, and the fertilizer requirements of rye, REMY (*Jour. Landw., 44 (1896), No. 1, pp. 31–103*).—After a discussion of the relation between the fertilizing materials taken up by the plants and the increase in plant substance, the author reviews the work of previous investigators in this line.

Experiments were conducted in 1891 and 1893 on 56 plats of 50 square meters each. Nitrate of soda 3 kg., carbonate of potash 3 kg., and superphosphate 3 kg. per plat were applied singly, two by two, and all three together.

Full tabulated data are given and discussed under the following heads: Effect of manuring (1) on the morphological development of rye, (2) on the yield; absolute quantities of fertilizing materials; assimilation of fertilizing materials, and the manurial needs of rye.

On the basis of the experimental data the author concludes that certain laws obtain in the relation between the assimilation of fertilizing materials and the production of dry substance in rye; that both processes, as well as the relations between them, are little affected by the manuring, and that the weather has more influence on these processes than the manuring.

It was found that a rapid assimilation of nitrogen took place in the

spring, and that this process appeared to last till shortly before ripening. The intensity of this process of assimilation in different stages of growth was very different. Valid general rules for the form and time of nitrogen manuring can not be given with exactness. The weather conditions are a considerable factor in the problem.

The small amount of nitrogen needed in the fall is supplied by the residue of former applications and by the natural provision in the soil. At the beginning of growth in spring is the most important time for applying nitrogen for rye.

As to potash, there is a large class of soils on which its application would be advisable for rye growing.

The assimilation of phosphoric acid is distributed quite uniformly over the whole period of vegetation. Rye must accordingly have the power to make a full use of an application of phosphoric acid that becomes gradually soluble. The most suitable time to apply phosphoric acid to rye seems to be in the fall.

Trifolium pannonicum (*Deut. landw. Presse, 23 (1896), No. 21, p. 180, fig. 1*).—The everlasting clover of Pannonia has not yet been cultivated as a fodder plant. It contains quite a high percentage of albuminoids. It is rather hairy, and on this account it must be cut at the beginning of bloom to be acceptable to cattle.

It has a deep, branching root, bearing several, often 20 to 30, upright stalks. It requires a deep soil. The flower heads are yellow, 4 to 8 cm. long, and the plant is dependent on insects for its fertilization. This clover has a special value in cold mountainous regions where red clover will not succeed. It stood the winter quite well in the Fürstenalp at a height of 1,782 meters above the sea.

A bed of 2 square meters yielded at the first cutting, June 2, 12.3 kg. green fodder; at the second cutting, Sept. 28, 8.0 kg., standing 60 to 70 cm. high before cutting.

Air-dry plants cut in bloom contained per 1,000 parts: Nitrogen, 19.6; ash, 102.9; phosphoric acid, 5.9; potash, 34.9; lime, 20, and magnesia, 3.4. Calculated to a water content of 14 per cent the proportion of food constituents is as follows:

Food constituents of Trifolium pannonicum.

	Crude albuminoids.	Crude fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
First cutting	12.28	1.49	45.42	30.40	10.24
Second cutting	12.18	1.89	48.33	27.35	10.25

Cultural experiments with American wheat, Ramm (*Deut. landw. Presse, 23 (1896), No. 24, pp. 205, 206, figs. 31*).—At Poppelsdorf on November 24, 1894, 5 varieties of American winter wheat were sown for trial at the rate of 80 lbs. per Prussian morgen. Notwithstanding

the severe winter, the stand in the spring was good, but the spring and summer drought shortened the harvest. The following are the yields of grain per hectare: Mold Red Prolific 2,737 kg., Reliable 2,478 kg., Tuscan Island 2,004 kg., Fulcaster 1,961 kg., Valley 1,811 kg., and Carman No. 1 1,573 kg.

The change in quality of the grain is striking, as shown in the following table, in which the weight of 100 kernels of the original seed is compared with the same grown at Poppelsdorf.

Weight per 100 kernels and per hectoliter of American wheat as sown and as harvested.

Variety of wheat.	Weight of 100 kernels. Original seed.	Weight of 100 kernels. Seed grown at Poppelsdorf.	Weight per hectoliter.
	Grams.	*Grams.*	*Kg.*
Mold Red Prolific	5,231	5,364	74.6
Reliable	4,295	5,480	75.8
Carman No. 1	3,769	4,870	71.8
Tuscan Island	3,628	3,330	74.0
Valley	2,999	4,877	70.8
Fulcaster	2,237	3,829	74.6

With the exception of the Tuscan Island, the size of the kernel was increased, and this was coincident with an improvement in quality; this was especially true of Reliable, as shown by the high weight of a hectoliter.

Report on agriculture and the culture of coffee in Mexico, SCHOENFELD (*Bul. Min. Agr. France, 56 (1896), No. 2, pp. 311–317*).—The part of this report referring to coffee is of especial interest. This crop has been grown successfully for many years and the area devoted to it has been tripled in the last 5 years. It succeeds best between the 18th and 22d parallels at altitudes varying from 3,500 to 4,500 ft. above the sea, *i. e.*, as near the frost line as it is safe to approach. The soil and culture are described at some length. The cost of production varies from 4 to 6 cts. per pound. The price is at present 14 to 16 cts. per pound. The plants commence to bear when 4 years old and live on an average 20 years.

Forage plants for South Dakota, T. A. WILLIAMS (*South Dakota Bul. 45, pp. 19, figs. 3*).—Descriptive and cultural notes, including results of experience at the station, are given on smooth brome grass, sheep fescue, hard fescue, red fescue, timothy, red clover, alsike clover, and white clover. Three mixtures of grass seed for sowing without nurse crops are suggested.

Variety test with sugar beets, mangel-wurzels, and potatoes, E. VON PROSKOWETZ, Jr. (*Die Sortenprüfung bei Zuckerrüben, Futterrüben und Kartoffeln. Vienna: W. Frick, 1895*).—It is stated that variety tests are more satisfactory than fertilizer tests and that the two should never be combined. Variety tests should be made on plats containing 100 to 200 square meters. To bring out only varietal characteristics the plats should be unmanured and have a homogeneous soil. A test should be repeated two, or better, several years. Corrections should be made for blank spaces.

Experimental results bearing on variety tests with sugar beets, mangels, and potatoes are given and discussed.

The conclusions are that there is no variety suited to all conditions; that every place makes its peculiar demands with respect to the variety; that the acceptance of foreign experience without investigation is a doubtful procedure; that for a particular farm results that shall be as free as possible from objection can be obtained

only through experiments carried out on the farm and continued through several years; and that such variety tests are an agricultural necessity.

Tobacco, M. POPOVICI (*Tutunul. Bucharest: F. Göbl Fii, 1896, pp. 136, figs. 28*).—This is a general treatise, giving the natural history of tobacco and the chemistry, culture, technical treatment, fermentation, and manufacture of extracts.

Harvesting seed leaf tobacco crop (*Amer. Agr. (mid. ed.) 58 (1896), No. 7, pp. 121, 122*).

The hardness of the grain in the principal varieties of wheat, N. A. COBB (*Agl. Gaz. N. S. Wales, 7 (1896), No. 5, pp. 279–298, figs. 28*).—Forty grains each of 54 varieties of wheat were tested for hardness for the crops of 1893, 1894, and 1895.

A study of new forage plants, C. and H. DENAIFFE (*Plantes fourragères nouvelles, étude. Carignan: 1896, pp. 49*).

HORTICULTURE.

Subirrigation in the greenhouse, W. J. GREEN and E. C. GREEN (*Ohio Sta. Bul. 61, pp. 57–76, pls. 5*).

Synopsis.—This bulletin discusses the construction of greenhouse benches and beds for subirrigation, the history of subirrigation, a comparison of surface and subirrigation, and the results of experiments in subirrigation. The latter is highly recommended as the best method of greenhouse watering. Notes on the culture of lettuce under glass are included.

In the construction of greenhouse benches for subirrigation watertight beds are necessary. These may be made of boards with the cracks battened and cement spread over the bottom to a depth of about half an inch and 1 to 2 in. thick at the angle with the sideboards. A better plan, however, is to construct the benches on racks of gas pipe a few feet above the ground, on which may be laid bottoms of tile, a size 12 by 24 in. being recommended. The sides of the benches may be made of ordinary roofing slate, 7 by 24 in., held in place, as are the bottom tiles, by means of iron clips and caps. After the tile and slate are in place, cementing is to be done as in the case of wooden benches. The irrigation tiles may be laid lengthwise or crosswise the beds; but if the runs are longer than 50 ft. there should be from 1 to 2 in. fall in that distance. Two-and-a-half-inch drain tile are considered cheapest and best, simply placed end to end in rows 2½ ft. apart, and opening on the surface at the upper end, where water may be poured in. To guard against a too rapid flow of water toward the lower end, strips of tin should be inserted in the joints of tile at intervals. From 6 to 10 in. of soil has been found sufficient for most purposes.

The history of subirrigation in the greenhouse is briefly discussed, the method, it is claimed, having been first tried at the Ohio Station. It is stated that watering by subirrigation is more cheaply and efficiently done than by the ordinary method, as both labor and water are saved and the moistening of the earth is distributed more evenly. The difficulty frequently met with in surface watering, due to the foliage of the plants preventing thorough watering of the soil, is obviated by subirrigation,

and by subirrigation the soil does not become compact. Experiments have indicated that plants are less liable to suffer from overwatering and diseases by subirrigation than when the water is applied to the surface; and all classes of plants that are usually grown upon greenhouse benches have been found to thrive best by subirrigation. It is believed that aëration of the soil is also favored by the presence of the tile. Many garden vegetables and ornamental plants have been successfully grown by this method.

Detailed notes and tabulated data are given of 10 varieties of lettuce grown by surface watering and subirrigation, with a gain in weight of from 40 to 100 per cent in favor of the subirrigated plants. The variety Grand Rapids was chiefly used in the experiment. The plants were started in flats, watered by being set in shallow vats of water, and transplanted as soon as the second leaf appeared, placing them 2 by 2 in. apart. The temperature was kept at 50 to 60° by day and 40 to 50° by night, as a higher temperature was found to favor the development of lettuce rot. Ventilation was also found to be important. It is stated that the plants may be sprinkled once when set in the bed, but after that it is not necessary, nor is there any need of sprinkling the walks in order to render the air moist. A subirrigated soil should be kept so that it is rather dry on top and wet enough below to retain the shape given it when pressed in the hand.

The illustrations are from photographs, showing different stages in the construction of greenhouse benches for subirrigation and comparing surface and subirrigated lettuce plants of the same age.

Cabbages, H. P. Gould (*Maine Sta. Bul. 24, 2d ser., pp. 4*).—Notes on experiments with cabbages to test the influence of size of seed, results of tying up the outer leaves, the effect of mulching, and to compare shallow and deep cultivation.

Three varieties were compared to test the effect of size of seed on the heads. In 2 varieties the larger seed was found to produce much heavier heads. Tying up of the outer leaves was found to have no influence upon the maturity of the head, as is popularly supposed, while it caused a marked decrease in size, and the moisture collecting within the leaves almost invariably caused the heads to decay. Mulching the plants with swale hay produced heads slightly larger than were borne by unmulched plants used as checks. But little effect on the size of the heads was produced by deep cultivation, but plants so treated appeared to mature more uniformly than when shallow cultivation was given. Tabulated data are given on the different experiments.

Garden peas, B. C. Buffum (*Wyoming Sta. Bul. 26, pp. 159–167*).—This consists of cultural notes and tabulated data for 38 varieties of peas that have been grown at the station for two or more years. In 1895 late frosts injured all varieties, more or less. Irrigation was given 4 times during the summer. Extra Early Premium Gem gave the heaviest weight of peas in the pod, amounting to 3 lbs. 9 oz.

per gallon. The average of the varieties was about $3\frac{1}{4}$ lbs. Of shelled peas, Lee Earliest proved the heaviest, a gallon weighing 1 lb. 11 oz. The yields, earliness, and hardiness of the varieties are compared, and the varieties Alaska, Sterling, Telephone, Telegraph, Admiral, Blue Imperial Dwarf, Black-eyed Marrowfat, and Melting Sugar are recommended for general planting.

Some market vegetables for Florida, P. H. ROLFS (*Florida Sta. Bul. 31, pp. 140–199*).—This bulletin gives cultural directions for the growing of several kinds of vegetables for market, preceded by directions for the starting of the plants. The adaptability of the light sandy loams of Florida for vegetables is discussed and detailed directions given for the construction of hotbeds, cold frames, and plant beds. The selection of the soil, planting, cultivation, preferable varieties, manuring, and marketing are discussed for beans, beets, cabbages, cauliflowers, celery, cucumbers, eggplants, lettuce, onions, English peas, and tomatoes. Directions are given for calculating the fertilizers required by different plants, and for each vegetable a fertilizer formula is given.

The subject of tomatoes is treated at some little length, the importance of good seed being emphasized, and considerable space devoted to the seed bed, hardening off, and setting the plants. Great care in picking and packing the tomatoes in crates just before they begin to turn red is urged, that the fruit may be as presentable as possible for market. The subject of canning is also briefly discussed, and it is believed that canning establishments are at present too uncertain investments to warrant their establishment without deliberate consideration. The following varieties are recommended: For shipping—Perfection, Aristocrat, Beauty, New Stone, and Paragon; for home use—Favorite, Beauty, Golden Queen, Royal Red, and Potato Leaf.

Apple culture in Wisconsin, E. S. GOFF (*Wisconsin Sta. Bul. 45, pp. 21*).—This bulletin is a compilation of notes and data gained from 172 apple growers in the State who responded to a circular letter sent out by the station containing a number of queries relative to varieties and methods. From the reports received the majority of the apple orchards of the State are located in the counties Waupaca, Rock, Walworth, Lafayette, and Kewaunee, although answers were received from orchardists in 19 other counties. Of the apple trees in the State 88 per cent belong to 27 varieties, of which Oldenburgh (Duchess), Wealthy, Fameuse, Longfield, McMahon, Whitney No. 20, Haas (Horse apple), Tolman Sweet, Tetofski, and Golden Russet are most cultivated. Of these 10 varieties but 3 are of Russian origin, which shows conclusively that there is much to be hoped for from the hardiest native varieties. The varieties Oldenburgh, Tetofski, Tolman Sweet, Haas, and Fameuse are cited as being most resistant to cold, in the order given. As regards productiveness, Oldenburgh, Longfield, Wealthy, Fameuse, and Hass lead in the order given, while Oldenburgh, Fameuse, Wealthy, Haas, McMahon, and Ben Davis sell best in market. A large

number of the correspondents reported having sprayed their apple trees, and the majority of those who did so found the results beneficial. As regards keeping the orchards in grass or giving them clean cultivation, 61 correspondents recommended keeping the soil constantly cultivated and usually growing some crop, while 62 would seed the orchard to grass after the trees are of bearing age. The vast majority of correspondents were in favor of planting Wisconsin-grown trees, while but 4 answers reported better success with eastern-grown trees.

The codling moth was reported the most serious enemy of apples, but borers, bark lice, tent caterpillars, cankerworms, and leaf rollers have been injurious to a small extent.

A table is given showing the varieties recommended by the different correspondents for an orchard of 100 trees, and another table indicates the varieties planted in 97 young orchards located in various parts of the State. The answers to several other inquiries of less importance and interest are given in condensed form.

The testimony of the correspondents shows that in the southern and eastern portions of the State apple culture is in a healthful and growing condition, although most of the orchards are small. It is believed that apple culture in Wisconsin will be carried on on a larger scale in the future.

The planting, pruning, and cultivation of the peach, W. F. MASSEY (*North Carolina Sta. Bul. 120, pp. 309–315*).—The planting of medium-sized budded trees, 1 year from the bud, is advised, and a dry soil inclined to sand, with a northern exposure, is recommended. June-budded trees are to be preferred to those budded in August or September. Directions are given for planting and pruning, it being urged that both roots and top be pruned. The formation of low heads should be encouraged. Clean shallow culture during the early part of the growing season and covering the ground with some leguminous crop during the fall and winter give the best results. For green manure cowpeas may be sown as soon as cultivation ceases in June, followed by the seeding of crimson clover among the cowpeas in August, both crops being plowed under in April. Fertilizers containing an abundance of potash and phosphoric acid are regarded as necessary. Brief remarks on the gathering of the crop, canning, and the preferred varieties for planting are appended. The sandy, hilly portions of the State are believed to be the best peach belts.

Revised opinions of the Japanese plums, L. H. BAILEY (*New York Cornell Sta. Bul. 106, pp. 30, figs. 13*).—This bulletin is supplementary to Bulletin 62 of the station on Japanese plums in North America (E. S. R., 5, p. 983). It is intended to extend, if possible, the knowledge of these fruits, which are believed to be adapted to a much wider range in the United States than are varieties of the domestic type. The Japanese plums are particularly desirable for earliness, great productiveness, almost complete freedom from black knot and leaf

blight, long keeping qualities, and beauty of fruit. In quality, however, they are inclined to be inferior to the domestic varieties. If for New York, late-blooming varieties should be selected, and little damage need then be feared from frost. The varieties Red June, Abundance, Burbank, and Chase seem to be entirely safe for planting in New York, and as second choice Georgeson, Maru, Chabot, Ogon, Berckmans, and Satsuma. For very early varieties Berger, Yosebe, and Willard may be planted, although the size and quality are not the best.

Descriptive, and in some cases illustrated, notes are given for 54 varieties, those which are better known and understood having rather detailed remarks devoted to them. The list of varieties contains also the names of several synonyms.

Prunes, apples, and pears in Oregon, U. P. HEDRICK (*Oregon Sta. Bul. 40, pp. 55–92*).—This bulletin is based upon data collected while making a horticultural survey of the State. It is stated that about 26,000 acres are devoted to prune growing in Oregon, mainly in the Willamette and Umpqua valleys. The Willamette Valley possesses a more humid climate than some of the other regions, and in consequence fungus diseases are rather more prevalent, while there are not so many insect pests. For the successful growing of prunes a rich sandy soil at least 4 ft. deep is best, with a well-drained black loam as second choice. The majority of prune trees in Oregon are grown on peach stock, but, in the opinion of the writer, the use of myrobolan plum stocks is to be preferred, as the range of soils upon which peaches will thrive is small, since they require better drainage than do plums. Prunes unite better with plum stocks. Plum stocks are less susceptible to borers and diseases, and in general in other fruit regions plum roots give better results. Good drainage to obviate puddling of the surface during the rainy season and to allow of cultivation is urged. In some cases subsoiling may be necessary.

Pruning the tops and roots of the trees before planting and setting them in straight rows at a time when the soil is dry enough to crumble are advised, a distance of not less than 20 or 22 ft. having proved the best. Early, clean cultivation should be given, and in young orchards the land may be deeply plowed for a few years. The trees should be pruned to low rounded tops, having the branches well distributed on the different sides of the trunk. Much larger and better prunes can be obtained by thinning the fruits. This should be done when the prunes are quite small, and the quantity removed must depend upon the variety and vigor of the tree. It is believed that some varieties of prunes are inclined to be self-sterile, and that to provide for the proper fertilization of the flowers an orchard should be planted with mixed varieties. The shot-hole fungus, borers, and the green aphis were found to be the most abundant enemies of the prune. Descriptive notes are given for 11 varieties of prunes, the Italian prune, French or Petite prune, and Silver prune being considered the best. Brief remarks are

made upon evaporators for drying prunes, and upon the budding ndustry of shipping fresh prunes East. From data obtained from 132 prune growers it is shown that the average expense of planting and caring for a prune orchard amounts to $41.80 per acre for the first 4 years. The net profit of the 1894 crop averaged $104.50 per acre.

General directions are given for the preparation and care of apple orchards and the renovation of old orchards. Apples in Oregon suffer more from pests than other fruits, the apple scab and codling moth doing most damage, but being readily controlled by spraying with a combination of Bordeaux mixture and Paris green. Practically but 7 varieties of apples are grown in the State for commercial purposes—Spitzenburg, Ben Davis, Yellow Newtown Pippin, Baldwin, Red-cheeked Pippin, and Northern Spy, named in the order of acreage.

Pear growing in the State is as yet conducted on only a small scale, but a few thousand acres being planted to this fruit. Pears from the Rogue River Valley seem to be of firmer texture, and consequently ship better. A deep, mellow clay loam is recommended, with tillage, and pruning the trees to a pyramidal top. The chief pests are the scab, woolly aphis, pear blight, and pear mite. Bartlett, Winter Nelis, Tyson, Seckel, Clapp, and Flemish Beauty are the favorite varieties grown.

Currants, S. A. BEACH (*New York State Sta. Bul. 95, n. ser., pp. 413–444, pls. 5, figs. 4*).

Synopsis.—This bulletin treats elaborately of a number of varieties of currants tested on the station grounds, giving cultural notes, data on yields, and illustrated descriptions of varieties.

Ninety-three varieties of currants are comprised in the station collection, of which 53 are station seedlings, the remainder being named varieties, including 18 red, 6 white, and 10 black kinds, 1 red and white striped, 3 varieties of *Ribes aureum*, 1 of *R. floridum*, and 1 of *R. sanguineum*. The ground upon which they are grown is a well-drained clay loam with clay subsoil, sloping to the south. The bushes are set 4 ft. apart in 6 or 7 foot rows, and each plant is given a forkful or two of stable manure in the fall. Shallow summer cultivation is given until August, and in the fall the bushes are pruned, all canes of 5 years old being removed.

Eighteen varieties of the common red currant (*Ribes rubrum*) are described, and the varieties Cherry and Fay are regarded as among the most desirable on account of bearing large, thin-skinned fruit, well filled with rich juice or pulp. Prince Albert, London Red, and Victoria have given larger average yields, but the fruit is smaller, and in the case of London Red the clusters are very short. Of the 6 varieties of white currants (*Ribes rubrum*) described, White Dutch gave the largest yield for 1894 and 1895, followed by White Grape and Champion. Prince of Wales was the most productive of the 10 varieties of European black currant (*Ribes nigrum*) cultivated, followed by Common Black

and Lee. The highest average yield per bush of the foreign varieties for the past 3 years was 8.86 lbs. for the red, 6.19 lbs. for the white, and 5.45 lbs. for the black varieties. Two varieties of the native black currant (***Ribes aureum***), indigenous to the Western prairies of the United States, were grown. Of these the variety Jelly averaged larger and had a better flavor than the slightly more productive variety Crandall. The annual yields of each of these varieties was less than a pound per bush for the last 3 years.

For propagation of currants the cutting method is preferred, the cuttings to be made from ripe, hard wood in the fall, stripped of their foliage if need be, and either planted at once, if early in the season, or tied in bunches and buried about 6 in. deep in the earth until spring, with the buds upward to keep the top buds dormant. In this case the cuttings may be set out as soon as the ground is fit to work in the spring. The soil for growing cuttings should be rich, well drained, and thoroughly pulverized, and the cuttings should be placed in long trenches with the top buds just above the surface. Strong 1-year-old plants are regarded as the most desirable for setting. Directions are given for propagation by layers and from seed, the latter method to be used when it is desired to originate new varieties.

Currants may be planted either in fields to themselves or in vineyards between the trellises. The distance between the bushes varies with the vigor of each variety, but about 4 ft. apart in 6-foot rows is considered a good practice.

Annual fertilizing with barnyard manure and some commercial fertilizer is considered necessary, and clean, shallow cultivation should be given until the end of summer. Pruning in either bush or tree form is regarded as preferable to allowing old canes to remain on the plants.

Brief descriptive and remedial notes are given on the currant worm, currant borer, 4-lined leaf bug, leaf spot disease, and leaf blight. In addition a note is made on an unknown fungus disease which infests currant canes in the Hudson River Valley, and for which no remedy has yet been suggested.

Orchard spraying and notes on raspberries, W. J. GREEN (*Ohio Sta. Bul. 63, pp. 97–113*).—This bulletin consists chiefly of directions for spraying various orchard fruits, with remarks on the principles to be followed.

Experiments in spraying apple trees in different parts of the State have resulted in the preservation of the foliage of sprayed trees and in reducing premature dropping of apples from the sprayed trees. It is urged that young trees be sprayed as soon as planted, using the same precautions against fungi as advised for bearing trees, and attempting by this means to prevent fungus diseases from gaining a foothold. It is advised that 2 or 3 sprayings be given with Bordeaux mixture, one before the leaves are open and another just before the time of blooming. After the apples have set, 1 or 2 sprayings with a combination of

Paris green and Bordeaux mixture should be given. Owing to considerable differences in susceptibility of different varieties of apples to scab and to injury from spraying mixtures, the strength of the solutions employed will depend on the varieties to be treated. Some varieties are so naturally resistant to the scab that but slight advantage has followed the spraying.

For pears much the same course as for apples is recommended, care being taken not to spray late, as the fruit of some varieties is easily injured by the Bordeaux mixture, which produces a russet appearance, especially on Angoulemes and Bartletts. White Doyenne, Flemish Beauty, Vicar, Angouleme Clairgeau, and Bartlett are mostly benefited by spraying.

Plums should be sprayed with both Bordeaux mixture and Paris green to prevent premature dropping and also to keep the curculio in check. About 4 applications of Bordeaux mixture and Paris green should be given, followed by the use of the curculio catcher. Peaches and American plums should be sprayed with a mixture of about half the strength that is used for foreign varieties of plums, as the foliage is more easily injured.

Directions are given for preparing Bordeaux mixture, ammoniacal copper carbonate, potassium sulphid, white hellebore, and the arsenites. A summary gives in condensed form directions for spraying several sorts of orchard and small fruits. Remarks are made on appliances that are thought best for use in spraying. A large apparatus worked by two or more men, and supplied with about 25 ft. of hose with a Vermorel nozzle at the end of a 10-foot length of quarter-inch gas pipe, is recommended.

Descriptive notes are given for 21 varieties of yellow, red, purple, and black raspberries.

The final summary recounts the most important points made in the bulletin.

An asparagus bed, H. MILLER (*Amer. Gard., 17 (1896), No. 83, p. 472*).— Cultural notes, chiefly urging the abundant use of barnyard manure in the fall, all weeds being kept down.

Comparative fertilizer tests with chemical fertilizers, R. OTTO (*Gartenflora, 45 (1896), pp. 66–72; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 221–225*).—Several varieties of cabbages were experimented upon with various pure mineral salts.

Composition of various melons, W. BERSCH (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 473–476*).—Proximate analyses are given of watermelons, muskmelons, and Persian melons.

One of Uncle Sam's truck gardens (*Amer. Gard., 17 (1896), No. 83, p. 468*).—A short account of the vegetable garden operated by the Soldiers' Home at Los Angeles, California, with a table giving the yield of each vegetable for each month in the year.

The propagation of tender plants, W. H. TAPLIN (*Gard. and Forest, 9 (1896), No. 440, p. 307*).—Cultural notes on several tropical greenhouse plants.

Chemistry of the apple, J. J. WILLIS (*Gard. Chron., ser. 3, 20 (1896), No. 499, pp. 63, 64*).—Recounts investigations carried on by the Ottawa Experimental Farms, and

gives tables showing analyses of the leaves and fruit. The fertilizing constituents withdrawn from the soil are discussed.

On the composition of Mespilus germanica, W. BERSCH (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 471–473*).—Proximate analyses are given of the whole fruit and various portions of the medlar (mespel).

The reproduction of the orange from seed, H. J. WEBBER (*Gard. Chron., ser. 3, 19 (1896), Nos. 496, pp. 784, 785; 497, p. 10*).

The barberry (*Canadian Hort., 19 (1896), No. 7, pp. 217, 218, pl. 1*).—A brief note on *Berberis vulgaris*, with a colored illustration of the flowers and fruit of *B. vulgaris purpurea.*

Edible barberries (*Garden and Forest, 9 (1896), No. 440, pp. 308, 309*).—The different colored fruits of several varieties are briefly noted, and their value for jams and jellies urged.

Currants (*Canadian Hort., 19 (1896), No. 7, pp. 219, 220*).—Brief suggestions for the use of this fruit in making jelly, jam, preserves, wine, and for eating raw or stewed.

Austin Improved or Mayd Hybrid dewberry, J. NIMON (*Rural New Yorker, 1896, June 20, p. 413, figs. 2*).

Winter protection for bush fruit, F. W. CARD (*Garden and Forest, 9 (1896), No. 439, p. 298*).

The ripening of grape wood and the effect of copper upon it, SCHLUSS (*Deut. landw. Presse, 23 (1896), No. 52, pp. 462, 463*).

Grape growing on sandy soil (*Gard. Chron., ser. 3, 20 (1896), No. 498, p. 39*).

Progress in the hybridization of roses, PENZANCE (*Gard. Chron., ser. 3, 20 (1896), No. 499, p. 65*).—Recounts experiments in crossing and obtaining new varieties.

History of the grape and fig, J. CAILLOT (*Historique de la vigne et du figuier. Argenteuil: Robert & Co., 1896, pp. 23*).

Odor of flowers (*Amer. Gard., 17 (1896), No. 83, p. 473*).—Cites experiments with *Orchis bifolia* to determine the time of greatest fragrance of bloom. It was found that the strongest odor was from twilight to dawn, and that the fragrance ceased upon the fertilization of the blossoms. The flowers of *Maxillaria aromatica* completely lost their perfume within half an hour after hand pollination.

The summer watering of plant boxes, vases, etc., E. A. LONG (*Amer. Gard., 17 (1896), No. 83, pp. 465, 466, fig. 1*).—Directions for watering potted plants so that the water will not run off the dry surface. A concave surface is recommended.

SEEDS—WEEDS.

Influence of certain substances used as fertilizers on germination, CLAUDEL and CROCHETELLE (*Ann. Agron., 22 (1896), No. 3, pp. 131–142*).—A series of experiments was conducted by the authors to test the effect that certain fertilizers exert upon the germination of seed. The tests were made in rather shallow porcelain trays containing calcined and thoroughly washed sand. The seed came in direct contact with the fertilizers used as the more soluble ones were applied in solution, the others finely powdered and well mixed with the sand. The seed were uniformly covered to a depth of 8 to 10 mm., and provision made for maintaining uniform moisture in all the tests. The following table (p. 56) shows the total germinations at the end of 18 days' testing, the fertilizers having been applied at the rate of 1 part per 1,000.

Germination of seed as affected by fertilizers.

Kind of seed.	Number planted.	Number of seed sprouted.							
		Check.	Sulphate of potash.	Chlorate of potash.	Sulphate of ammonia.	Ammoniated superphosphate.	Slag.	Nitrate of soda.	Liquid manure.
Sainfoin	10	3	5	2	7	8	8	7	9
Lupine	6	6	6	2	2	2	6	....	6
Vetch	20	10	4	2	....	6	13	....	12
Beans	6	5	4	2	....	4	6	....	6
Peas	8	8	5	3	....	4	5	....	8
Lentils	16	11	3	2	....	3	6	....	13
Alfalfa	20	2	11	0	....	13	12	....	....
Rape	20	19	19	17	....	19	18	16	19
Mustard	20	10	14	10	3	14	19	17	....
Flax	20	12	13	1	....	7	17	....	13
Wheat	10	9	10	9	9	9	10	9	10

From the table it will be seen that the potash fertilizers checked germination, the chlorate exercising the most unfavorable influence. The sulphate of ammonia has a very destructive effect upon the germination of all the seed with the exception of the sainfoin and wheat.

Experiments were made with different strengths of sulphate of ammonia and nitrate of soda, using ½, 1, 2, and 5 parts per 1,000. The results are tabulated, in which it is shown that wheat, barley, and oats are practically uninjured up to and including the 0.2 per cent application of sulphate of ammonia. Clover and beans were retarded in their germination by all, and rape was checked by all except the lowest per cent. It was also found that 0.5 per cent arrested the germination of all seed tested. With nitrate of soda applied as above, barley was the only seed uninjured by the strongest applications; wheat, beets, and rape were somewhat checked by the 0.2 per cent, while buckwheat, beans, and clover were greatly checked by the same strengths.

Experiments were conducted with winter vetches to test the effect of phosphates and lime upon their germination, and it was found that the basic phosphates of lime assist in germination, while the acid phosphates are injurious.

Liquid manure, it is said, not only hastens the germination of most seed, legumes especially, but has a permanent effect upon the young plant.

In summarizing his results the author states that in the strengths used and in immediate contact with the seed, sulphate of ammonia, nitrate of soda, chlorate and sulphate of potash, and ammoniated superphosphates exert an injurious effect upon the germination of seed in general. All kinds of seed are not equally susceptible to the influence of fertilizers upon their germination. Alkaline substances having lime or potash for their base favor the germination of many kinds of seed, legumes especially. Slag and liquid manure are said to give better results than lime alone.

The acidity of 17 species of germinated seed is given, ranging from 1.612 per cent in clover to 0.108 in flax, and the authors conclude that

the lime, slag, and liquid manure are beneficial in proportion as they neutralize the acid formed during the processes of germination. By the entrance of these alkaline substances the loss of phosphoric acid in the seed is prevented, and the acid phosphate of lime is transformed into a less soluble form, which will serve as a phosphoric acid reserve of the plant.

Average results of Danish seed control, 1886–'95, E. ROSTRUP (*Lommebog f. Landm.* (*Holt*), *1896*, *pp. 74–77*).—The principal data obtained in the seed examinations by the Danish Seed-Control Station, 1886–'95, are given in the following table. Varieties of seeds, of which less than 50 different samples were examined, are not included in the table, and only complete analyses of commercially pure seed, the quality of which the seedsmen are willing to guarantee, were considered in making up the averages:

Average results of Danish seed control, 1886–'95.

Name of seed.	Number of samples.	Weight per bushel.	Weight per 1,000 kernels.	Foreign seed.	Refuse.	Purity.	Germination of pure seed.	Pure germinated seed.
		Lbs.	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Red clover	1,957	53.8	1.753	0.4	3.0	96.6	*a* 98.7	86.2
White clover	636	54.5	.633	1.8	2.2	96.0	*a* 97.3	77.9
Alsike clover	546	54.4	.658	1.9	1.5	96.6	*a* 97.5	82.7
Black medick	370	55.0	1.580	.2	1.6	98.2	*a* 94.3	85.1
Anthyllis vulneraria	80	52.8	2.510	2.3	4.6	93.1	*a* 97.3	82.1
French rye grass (*Avena elatior*)	591	11.3	3.549	4.4	11.8	83.8	83.5	70.0
Velvet grass (*Holcus lanatus*)	77	5.6	.442	4.6	26.4	69.0	80.9	55.8
Meadow brome grass	248	11.9	1.924	2.6	3.0	94.4	91.6	86.5
Orchard grass	940	14.5	.992	2.4	11.5	86.1	87.0	74.9
English rye grass	762	22.4	2.039	2.5	1.4	96.1	89.9	86.4
Italian rye grass	504	18.9	2.047	1.1	1.9	97.0	85.6	83.0
Rough meadow grass (*Poa trivialis*)	128	19.8	.179	1.9	9.3	88.8	82.9	73.6
Kentucky blue grass	75	22.9	.245	1.3	7.2	91.5	71.0	65.0
Meadow foxtail	175	9.1	.859	1.2	16.3	82.5	69.5	57.3
Meadow fescue	404	21.3	1.857	3.8	2.0	94.2	92.2	86.9
Festuca duriuscula	102	15.7	.774	.6	14.6	84.8	81.3	68.9
Timothy	583	39.4	.422	.9	.7	98.4	94.1	92.6
Two-rowed barley	82	47.4	48.872	.1	.6	99.3	96.9	96.2
Ruta-baga	59	42.1	2.943	....	1.8	98.2	96.8	95.1
Turnip	71	44.3	2.049	....	2.3	97.7	98.0	95.7
Carrot	148	21.1	1.255	.1	10.8	89.1	76.2	67.9
Fodder beet	346	16.3	23.823	.1	1.3	98.6	88.2	87.0

a The "hard" seeds are included.

—F. W. WOLL.

The Russian thistle, E. O. WOOTON (*New Mexico Sta. Bul. 16*, *pp. 20*, *pls. 2*).—This plant was first recognized in the Territory in 1894, and it seems to be pretty well established in the vicinity of Santa Fé and possibly at Roswell. The author advises that every effort be made to eradicate it while the weed is confined to a restricted range, an especial warning being given of its possible distribution through the agency of irrigating ditches. Technical descriptions are given of the plant. Several other weeds are mentioned which are sometimes mistaken for it, and their most striking differences are pointed out. Various sources have been drawn upon for the habit of the plant, its distribution, and suggested means for its extermination.

Concerning the relation between the absolute weight and composition of leguminous seed, W. G. WALLIG (*Inaug. Diss. Jena, 1894, pp. 37; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, p. 228*).

Germination tests of Swedish seeds, L. J. WAHLSTEDT (*Rpt. Kristianstad Seed Control Station, 1894–'95, pp. 13, 14*).—A report is given of the tests of about 4,000 samples of seed tested at the station during the years 1879 to 1895. The principal seed tested were various grains, leguminous forage plants, and grasses.—F. W. WOLL.

On the examination of grass and clover seed in respect to their purity and the impurities which they contain, F. F. BRUIJNING (*Extr. Archiv. Teyler, ser. 2, 5 (1896), No. 1, pp. 44, pls. 6*).

On the importance of the origin of clover seed (*Landmansblade, 29 (1896), pp. 71–73*).

On a new germinating apparatus, A. SEMPOLOWSKI (*Deut. landw. Presse, 23 (1896), No. 52, p. 462*).

Report of Kristianstad Seed-Control Station, 1894–'95, L. J. WAHLSTEDT (*Kristianstad (Sweden): 1896, pp. 15*).

On the extirpation of hedge mustard (*Deut. landw. Presse, 23 (1896), No. 42, p. 369*).

Weeds on Swedish moorland cultures, R. TOLF (*Svenska Mossk. Fören. Tidskr., 1895, pp. 329–334*).

Weeds and how to eradicate them, T. SHAW (*St. Paul: Webb Pub. Co., 1896, pp. 210, figs. 22*).—This volume, which is the outcome of much study and experiment in dealing with weeds, will no doubt be found suggestive to anyone desiring to rid his ground of troublesome weeds. Chapters are devoted to the prevalence of weeds, evils arising from their presence, possibilities of their destruction, agencies of distribution and propagation, methods and principles generally applicable to the destruction of weeds, specific suggestions for the destruction of many troublesome weeds, and specific modes for eradicating some of the most serious weed pests of the western prairies, such as the Russian thistle, Hungarian mustard, penny cress, wild prickly lettuce, foxtail, and wild buckwheat. Most of the weeds are so well known as to be easily identified with the aid of the descriptions given, but unfortunately some of the illustrations are so poorly executed as to be beyond recognition. The use of bare fallow and fermenting manure as means for weed eradication are considered as of doubtful value. The practicability of having a farm clear of weeds if sufficient energy be put into practice in the methods of eradication advised is demonstrated.

DISEASES OF PLANTS.

The principal diseases of citrus fruits in Florida, W. T. SWINGLE and H. J. WEBBER (*U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 8, pp. 42, pls. 8, figs. 6*).—The authors have described and illustrated 6 of the principal diseases attacking citrus fruits in Florida as follows: Blight, die-back or exanthema, scab or verrucosis, sooty mold, foot rot or mal-di-gomma, and melanose. Some of these diseases have been under investigation for a number of years, and preventive measures are suggested.

The blight, also called wilt and leaf curl, is, so far as known, confined to Florida. Nearly all citrus fruits are liable to its attack, and at present it is considered incurable. All infected trees should be dug up and burned as soon as they show signs of the disease, as it is considered contagious. The annual loss due to this disease is estimated at $150,000. Blight attacks bearing trees 5 or more years old, and its

presence is first indicated by a sudden wilting of the leaves, which continues in bad cases even during wet weather. The whole top may be attacked at once, or only a single branch. The spring following the wilting of the top the branches which have become nearly leafless bear abundant small flowers, which continue to appear for 2 or 3 weeks after the normal period for blooming. Little if any fruit is set, and the branches usually die after blooming. The affected trees usually linger for a few years, becoming reduced to stumps by the dying of the branches. The roots for the first year appear normal.

Die-back, which is estimated to cause at least $100,000 loss annually, receives its name from the behavior of the diseased trees, a few inches of the vigorous growth dying back early in the spring. The disease is apparently caused by malnutrition, improper drainage, improper cultivation, etc., and may be recognized by the very large, dark, pointed leaves and the reddish-brown stains on the new-growth twigs, which finally die back for some distance. Diseased trees bear little fruit, and that formed assumes a pale-green color and ripens prematurely. The fruits are commonly more or less disfigured by the characteristic reddish-brown stain. It has been found that withholding organic manures, mulching the soil, ceasing cultivation, and, where necessary, thorough drainage, will prevent or greatly reduce attacks of this disease.

Scab, or verrucosis, a disease which attacks sour oranges and lemons, is due to *Cladosporium* sp., and its attacks may be prevented on lemons by spraying the young fruits 3 to 5 times with ammoniacal copper carbonate solution. The fungus causes small excrescences upon the young leaves and fruits. These excrescences are pale watery green at first, becoming darker with the development of the fungus. When the attack is made upon the fruit while it is quite small the fruits become covered with warts and bumps which render them unsalable. The loss occasioned by this disease is estimated at about $50,000 annually.

The sooty mold is due to a black fungus which follows attacks of honeydew-secreting insects. A description of this disease was given in Circular 15 of the Division of Vegetable Pathology (E. S. R., 7, p. 737), in which resin washes were recommended. Fumigation with hydrocyanic-acid gas is also an effective remedy.

Foot rot, or mal-di-gomma, is one of the most widespread and destructive diseases of citrus trees. It may be recognized by the exudation of gum from definite patches near the base of the tree. Later the diseased bark curls up and falls off. The disease spreads downward to the roots and around the tree, finally girdling it and causing the death of the tree. Accompanying symptoms are sparse foliage, small yellow leaves, and the dying of small limbs over the tree. While probably contagious, it is thought that improper aëration of the roots is conducive to the disease. Sweet seedling oranges and lemons are most subject to the disease, while grape fruit is attacked but slightly and

sour oranges escape almost entirely. The use of sour orange stocks for low lands and grape fruit stocks for the dry pine lands will greatly aid in preventing the disease. Exposing the crown and upper roots, cutting away diseased portions, and treating the cut surfaces with sulphurous acid, carbolic acid, or sulphur wash is recommended. The use of nitrogenous organic manures, excessive cultivation, and irrigation are to be avoided.

Melanose attacks all citrus fruits, and seems capable of causing considerable damage should it become widely distributed. At present it is reported from but a few localities in Florida. It forms minute brown spots on the leaves, twigs, and fruits. On the fruit, which is attacked only while young, the spots run together, staining considerable areas, lemons being rendered unsalable by such an appearance. In bad cases the trees are damaged, while ordinarily it is the fruit which suffers. The cause of the disease is probably parasitic, and it may be controlled by the use of Bordeaux mixture or ammoniacal copper carbonate.

Report of the botanist, L. R. JONES (*Vermont Sta. Rpt. 1894, pp. 93–118, figs. 9*).—Detailed reports are given of experiments in spraying potatoes, observations upon the date of planting potatoes, prevention of potato scab, on the prevention of apple and pear scab, occurrence of oat smut, observations on grasses and weeds, and some studies upon carnation rust. The principal topics are revised reprints from Bulletin 44 of the station (E. S. R., 6, p. 999), some of which are reported upon at greater length than in the bulletin.

A tabular report is given of the gains from spraying potatoes with Bordeaux mixture in 1894, in which gains of from 12 to 30 per cent in favor of the treatment are shown.

Comparative tests were made to determine the relative value of the following fungicides for spraying potatoes: "(1) Stronger and weaker Bordeaux mixture, (2) Bordeaux mixture in the form of dry powder, (3) Bordeaux mixture which had stood some time after preparation, (4) Bordeaux mixture made by the potassium ferrocyanid test, (5) modified eau celeste, (6) ammoniacal copper carbonate, and (7) soap as added to liquid fungicides."

In every case the Bordeaux mixtures gave the best results, their relative value being about in the order of the enumeration of their strengths.

During 1894 9 fields were sampled for the presence of oat smut, and the amount found ranged from nothing to 3.7 per cent, with an average of 1.7, a slight increase in the amount of smut as observed during the previous year.

Notes are given of experiments with grasses for sowing on overflowed river bottom lands. The most promising species for this purpose is fowl meadow grass, *Poa serotina*, and experiments will be continued with it.

Brief notes are given calling attention to several species of weeds which once established may prove very troublesome.

A report is given of some studies upon carnation rust. These studies were conducted along 3 lines: (1) effect of chemicals upon the germination of the spores, (2) inoculation experiments, and (3) spraying experiments. About 250 experiments were conducted with varying strengths of copper sulphate, Bordeaux mixture, ammoniacal copper carbonate, eau celeste, iron sulphate, potassium sulphid, potassium chromate, potassium bichromate, lead acetate, corrosive sublimate, carbolic acid and salt to test their ability to prevent spore germination. The stronger solutions of all except the last were successful to a greater or lesser degree. The inoculation experiments conducted were successful only where the epidermis had been punctured. Experiments were conducted for the repression of rust by spraying plants with the strengths of the chemicals above referred to which had proved successful in preventing spore germination. When the final examination of the plants was made no injury was perceptible.

Experiments for checking apple rot and codling moth in 1895, H. GARMAN (*Kentucky Sta. Bul. 59, pp. 113–129, pls. 4.*)—The experiments reported upon in this bulletin were in continuation of tests made during previous seasons with a view of finding some practicable means for the prevention of the injuries of the apple rot (*Sphæropsis malorum*) and the codling moth. It is desirable that applications for both pests should be made at the same time; and the time, number of applications, and strength of solutions should be determined. For the experiments of 1895 10 trees were selected, 5 of which were sprayed, the others being left as checks. The fungicide used in most of the experiments was Bordeaux mixture made by the following formula: Copper sulphate 6½ lbs., lime 3½ lbs., water 32 to 33 gals. The author used 4 or 5 applications. These were made April 4, May 6, 8, and 29, and July 12; or where 4 applications were given the trees, that of May 29 was omitted. A heavy rain falling soon after the spraying of May 6 necessitated a second on May 8. Paris green was added to the Bordeaux mixture for every application except the first.

When the apples were gathered they were assorted into sound ones and those showing attacks of disease. These 2 lots were then inspected for evidence of codling moth attack. In the accompanying table the results of the tests are shown:

Result of spraying to prevent apple rot and codling moth.

No. of experiment.	Kind of tree.	No. of sprayings.	Total number of apples.	Per cent of decayed fruit.	Per cent of fruit attacked by codling moth.	
					Sound.	Rotten.
501	(a)	5	437	47.5	13	61
502	Check		29	65.5	70	84
503	Russet	4	1,112	21.5	16	49
504	Russet check		385	28.0	39	65
505	Ben Davis	5	1,686	20.0	18	39
506	Ben Davis check		533	22.0	48	64
507	Janet	4	2,597	28.0	34	44
508	Janet check		774	55.0	24	63

a Name of variety not given.

The effect of the spraying was especially noticeable in the condition of the sprayed trees and in the greater number of apples that remained upon the trees until the crop was picked. While the reduction in the percentage of rot was small, yet in every case the smaller yield of rotten fruit was from the sprayed tree of each pair.

The substitution of iron sulphate for the copper sulphate in Bordeaux mixture was tested. In other respects the applications were the same in time and amount. While the test was not wholly satisfactory, the author thinks iron sulphate will be less effective in checking rot than Bordeaux mixture made in the usual way.

Six apples weighing 420 gm. were tested for the quantity of copper and arsenic present. In the peelings and cores 0.0004 gm. of copper oxid was found with a minute trace in the flesh, and of arsenic a trace too small for measurement was found in peelings and cores but none in the flesh. The small quantity of each could not be considered at all injurious.

Potato blight, L. R. JONES (*Garden and Forest, 9 (1896), No. 428, pp. 188, 189.*)—The author calls attention to the confusion which exists in the nomenclature of the potato blights. The late blight due to *Phytophthora infestans* is well known, but under the term early blight are confused several distinct conditions. The author states that the early blight proper is due to *Macrosporium solani*, and is characterized by the appearance of numerous sharply defined dark spots scattered irregularly over the leaf. These spots, enlarging slowly, give rise to the peculiar arrangement of concentric rings. The spots may or may not have originated with bites of flea beetles, but the fungus is more liable to attack plants that have become weakened from any cause.

A second form of disease is distinguished from early blight by the name "tip burn," and is characterized by drying at the tips and margins. It is attributed to dry hot weather, insufficient water supply, and is aggravated by insect injuries. Numerous fungi are associated with this disease, but they are present as saprophytes.

A third injury is recognized as due to too strong applications of arsenites. The appearance of the spots is very much like that caused by the Macrosporium, except for more regular outline and slight difference in color.

A fourth disease is recognized in which dead spots occur on the margins of leaves or around the flea-beetle punctures. They do not seem due to either of the above causes, and are probably caused by too great dry heat. In this respect this disease resembles the disease described under the name of "tip burn."

Comparative investigations of the important agricultural smuts, P. HERZBERG (*Beiträge Physiol. und Morph. niederen Organismen, 1895, No. 5, pp. 1–36, pls. 3; abs. in Bot. Centbl., 65 (1896), No. 6–7, pp. 231–233*).

Cotton blight (*Indian Textile Jour.; Indian Agr., 21 (1896), No. 9, p. 274*).

An outbreak of asparagus rust, B. D. HALSTED (*Garden and Forest, 9 (1896), No. 449, pp. 394, 395*).—A description is given of the asparagus rust due to *Puccinia asparagi*, and the burning of all affected plants is recommended as a precautionary measure.

Notes on the Cladosporium of the apple, P. A. DANGEARD (*Le Botaniste, ser. 4, 1895, pp. 190–195; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, p. 176*).

Ripe rot of plums (*Canadian Hort., 19 (1896), No. 7, pp. 220, 221, figs. 2*).—Brief notes, mostly quoted from a bulletin of the New York State Experiment Station.

Die back, E. S. HUBBARD (*Florida Farmer and Fruit Grower, 8 (1896), No. 20, p. 467*).—Discusses remedies, recommending no cultivation during the rainy season, and applications of ammonium sulphate.

The larch disease, L. CAPUTH (*Gard. Chron., ser. 3, 20 (1896), No. 500, pp. 93, 94*).

Causes of browning of leaves, COSTE-FLORET (*Prog. Agr. et Vit., 26 (1896), No. 29, pp. 63–67*).

Beet nematodes and their repression (*Deut. landw. Presse, 23 (1896), Nos. 55, p. 489; 57, p. 508; 59, pp. 525, 526, figs. 2*).

Eel worm disease in onions, E. A. ORMEROD (*Agl. Gaz., 44 (1896), No. 1175, p. 9*).—This treats of the ravages of *Tylenchus devastatrix* attacking onions in England this summer for the first time. The species has been known in Holland for a number of years.

On the effect of sulphur during flowering, DE PALAMENY (*Prog. Agr. et Vit., 26 (1896), No. 29, pp. 79, 80*).—Applications of sulphur may be made to vines while in bloom without injury.

The treatment of chlorosis, G. GASTINE (*Prog. Agr. et Vit., 26 (1896), No. 37, pp. 307–309*).—An account is given of the successful use of solutions of iron sulphate.

Treatment of mildew by simple solutions of copper sulphate, G. BOURTHOUMIEU (*Prog. Agr. et Vit., 26 (1896), No. 27, pp. 8–10*).

The distribution of fungi in Germany, O. WUNSCHE (*Die verbreitesten Pilze Deutschlands. Eine Anleitung zu ihrer Kenntniss. Leipzig: B. G. Teubner, 1896, pp. 124; abs. in Bot. Ztg., 54 (1896), No. 17, pp. 269, 270*).

Spraying, U. P. HEDRICK and A. B. CORDLEY (*Oregon Sta. Bul. 41, pp. 95–108*).—This bulletin contains popular notes on the use of fungicides and insecticides, with formulas for the preparation of some of the best known. Some of the more injurious fungus and insect injuries are described, and the treatments required under the climatic and other conditions of the region are given. Some of the more common reasons for the failure of spraying are pointed out and suggestions offered for their avoidance.

ENTOMOLOGY.

Experiments in beekeeping, O. J. LOWREY, M. F. CRAM, and H. W. SCOTT (*Vermont Sta. Rpt. 1894, pp. 136–140*).—This consists of notes on experiments with bees and honey carried out under the general direction of the Vermont Beekeepers' Association.

Seventeen hives were placed in a room 6 by 24 ft., capable of accommodating 24 colonies. The bees having come from different sources were in different sized frames, and for this reason were observed closely to determine the best form of frame to adopt in the production of comb or extracted honey and for wintering bees. No perceptible difference has yet been noticed.

After the onset of frost, sugar sirup was fed in different ways to test the ability of bees to change cane sugar into honey sugar. Analyses are given of the honeys produced, pure honey, and honey that had been adulterated with cane sugar. It was found that the best honey was produced when a large quantity of sirup was fed to the bees rapidly. The resulting honey did not granulate. When sirup was fed in small quantities for a considerable time less sucrose was found on analysis,

but the product granulated. Stimulative feeding during the spring was tried, but was interrupted, and the results are inconclusive.

A non-swarming device was employed with 4 colonies of bees, but proved a failure so far as preventing any desire to swarm. Two strong colonies running together with a non-swarmer produced less comb honey than single colonies that were allowed to swarm at will.

During February and March, 1894, the temperatures of the apiary, of the interior of the hive, and of the outside air were taken and are shown in a table.

It is urged that the spraying of fruit trees be refrained from while the trees are in bloom to avoid poisoning the bees and in addition affecting the proper fertilization of the blossoms.

Mosquitoes and fleas, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circular 13, 2d ser., pp. 4*).—*Mosquitoes.*—It is stated that at least 21 species of mosquitoes are present in North America, of which the most common is *Culex pungens*. Observations on the life history indicate that a generation may be completed in 10 days, the egg stage lasting 16 hours, the larval stage 7 days, and the pupal stage 24 hours, although all of these periods may be lengthened by cool weather.

For protection against mosquitoes, the use of nets and screens in the windows and doors and about beds and the burning of pyrethrum in rooms to which mosquitoes have gained access are considered the best remedies against the pest indoors, while to prevent their breeding the draining of ponds and marshes, the introduction of fish in fishless ponds, and the use of kerosene on the surface of the water are strongly recommended. Experiments with applying kerosene to pools and ponds show that if an ounce of kerosene be applied to every 15 square feet of water surface the larvæ and pupæ in the pool and females alighting to lay their eggs will be killed. The applications should be repeated at intervals of about a month.

Fleas.—The flea causing most common annoyance is *Pulex serraticeps*, infesting the dog and cat. In case of an outbreak of fleas in the house freely sprinkling pyrethrum powder about the rooms, followed by spraying the carpets and floors with benzin, and as a last resort washing the floors with hot soapsuds are recommended as efficient remedies.

Climbing cutworms, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 104, pp. 553–600, pls. 5, figs. 2*).

Synopsis.—This bulletin contains general remarks on cutworms as a class, with additional descriptions and notes on climbing cutworms, and directions for successfully combating these pests.

Cutworms in general (pp. 555–560).—The habits and appearance of the moths and caterpillars, destructiveness, life history, and natural enemies of cutworms are briefly treated of, and it is stated that about 30 species occur in the State. Corn, onions, peach trees, and garden crops in New York have suffered most from attacks of cutworms.

Climbing cutworms (pp. 561–584).—Under this head are discussed several species of cutworms with the climbing habit, spending the day in the ground at the bases of trees and at night ascending the trunks and feeding upon the buds and leaves until nearly daylight. A large variety of shade and fruit trees are attacked by climbing cutworms, as are also small fruits, grapevines, and various flowers, especially roses and chrysanthemums. Among fruit trees, peaches have experienced most damage, perhaps because of their being extensively grown on the sandy soils, where cutworms flourish best. A list is given of 12 species of cutworms that have been noted as possessing the climbing habit, and it is believed that other species would assume it under favorable conditions. The greatest damage to peach trees has occurred along the shore of Lake Ontario, where in some instances the attacks of cutworms have been so severe that on still nights their feeding has produced a distinctly audible nipping sound. Each cutworm destroys several buds in a night, and when a number of caterpillars ascend a young tree it is soon killed or its growth distorted and stunted. Where the buds are few the branches are often girdled through the bark being gnawed. During the daytime these cutworms bury themselves in the sand about an inch below the surface, usually within a radius of a foot from the base of a tree. As many as 50 cutworms have been found at one time on a year-old tree and 120 on a 2-year-old tree. The history and distribution, description, habits, life history, and illustrations taken from photographs are given for the white cutworm (*Carneades scandens*), spotted-legged cutworm (*Porosagrotis vetusta*), well-marked cutworm (*Noctua clandestina*), dingy cutworm (*Feltia subgothica*), and variegated cutworm (*Peridroma saucia*). Of these the white cutworm constituted over 90 per cent of those that attacked peach trees in western New York in 1893 and 1894. The well-marked cutworm, dingy cutworm, and spotted-legged cutworm were next in respective abundance. The variegated cutworm was not found attacking peach trees, but was noticed several times damaging plants in greenhouses and gardens. The most damage it accomplished was in attacking chrysanthemums, which it did by eating into the blooms in a manner at first attributed to mice. The variegated cutworm is believed to be a European species, while the others described are of American origin.

How to combat cutworms (pp. 585–600).—The results of numerous experiments carried on at the station for preventing the ravages of cutworms are cited. Trapping the moths by means of sweet traps and trap lanterns is believed to involve more labor and expense than the results repay, besides destroying numbers of beneficial insects, especially parasites. To combat climbing cutworms, clean cultivation is advised, to keep out entirely all weeds and grasses upon which the eggs are laid and the young cutworms feed. Clean cultivation for two or three months after the middle of July, and the growing of some garden or field crop in or near peach orchards to attract the moths and

thus prevent them from attacking the trees, are suggested. To prevent the worms from getting to the buds the painting of the trunks of the trees with "Raupenleim," "Dendrolene," or some other sticky caterpillar lime has proved quite effective.

The mechanical devices which have been looked upon with favor are collars of stiff, smooth paper pulled out in funnel shape at the bottom and collars of cotton batting, a band of batting 4 or 5 in. wide being bound at its bottom around the tree and the top then pulled over in the shape of an inverted funnel. This has proved an effective barrier against cutworms and is not readily matted down by rain.

For killing climbing cutworms jarring them from the trees at night on to sheets and digging them out of the ground during the day, although tedious methods, have proved profitable. Poisoned baits of fresh foliage sprayed with Paris green and a moistened mixture of bran and Paris green were eagerly eaten by the cutworms, which died in a few hours, in some cases 90 per cent being killed. In gardens it is recommended that the advent of the cutworms be prevented by plowing deep furrows around the patches to be protected, and that such destructive measures as spraying with Paris green, hand picking, and the use of poisoned baits be employed. For grass lands and field crops a short rotation of crops, leaving fields but a short time in sod, is believed to be the best method of protection known at the present time.

Cutworms in Kentucky, H. GARMAN (*Kentucky Sta. Bul. 58, pp. 89–109, pl. 1, fig. 1*).—Owing to a marked outbreak of cutworms in Kentucky in 1895 special attention was paid to these pests, and specimens were sent to the station from various parts of the State. Descriptive and life-history notes are given for the traveling cutworm (*Feltia gladiaria*), dingy cutworms (*F. jaculifera* and *F. subgothica*), granulated cutworm (*F. annexa*), greasy cutworm (*Agrotis ypsilon*), variegated cutworm (*Peridroma saucia*), green cutworm (*P. incivis*), spotted cutworm (*Noctua bicarnea*), W-marked cutworm (*N. clandestina*), bristly cutworm (*Mamestra renigera*), glassy cutworm (*Xylophasia devastatrix*), and bronzed cutworm (*Nephelodes minians*).

Several species of cutworms were bred at the station for purposes of accurate identification. As remedial treatment are recommended burning of tracts suspected of harboring cutworms or known to do so, inclosing newly set plants with paper or tin cylinders, and the use of poisoned bait, which is to be prepared by dipping bunches of clover in Paris green water. Some of the worms in the laboratory investigation were found to be infested with bacteria and others with a fungus disease, which proved to be quite readily communicable, and which it is hoped may prove of advantage in destroying worms in the field.

Examination of the stomachs of bluebirds killed in February showed that on an average 30 per cent of the contents consisted of cutworms.

In addition, illustrated and descriptive notes are given on the army

worm (*Leucania unipuncta*), and winter burning of infested land is recommended.

The grape root worm, F. M. WEBSTER (*Ohio Sta. Bul. 62, pp. 77–95, pl. 1*).—This consists of notes on the appearance and life history of *Fidia viticida*, with an account of experiments in combating this pest in 1894 and 1895. This hoary chestnut-colored beetle was present in immense quantities in the northern portion of Ohio, especially in the vicinity of Cleveland. The several stages of the insect's life history are described in technical detail. The habits are briefly noted, there being but one annual brood, from eggs laid under the bark of grapevines in July and August, whence minute white, brown-headed larvæ hatch, drop to the ground, and make their way to the roots upon which they feed. They attain their full growth before winter, when they pass into earthen cells, developing into pupæ in June without further feeding, and emerging from the latter part of June until September, but mostly during July. The adults feed upon the foliage of the grapevines, commencing with the lower leaves and gradually ascending until later in the season they are found upon the youngest and most tender foliage. The upper surface of the leaves is the place of their attack. Sometimes the fruit is also eaten.

Ants and mites were found to attack the eggs of these insects, and 1 new hymenopterous genus, Fidiobia, and 2 new species, *F. flavipes* and *Brachysticha fidiæ*, were bred from the eggs and are technically described by W. H. Ashmead.

For the destruction of the adult beetles spraying with arsenites was employed with satisfactory results, but owing to the irregular emergence of the adults an abundance of beetles was always in evidence, the newcomers taking the place of those that had perished by the arsenites. Kerosene emulsion, salt, and kainit were applied about the bases of the grapevines for the destruction of the larvæ, but only kerosene emulsion was in any way effective. An application of bisulphid of carbon, 4 to 6 oz. per vine, was made by means of 3 holes, each about a foot from the base of the vine. When the soil was not too wet or too dry this was found to be an effective method, although it can not be used to advantage earlier than November on account of the prolonged season of oviposition. It is believed that additional treatment with bisulphid of carbon in the spring will be found advantageous.

It is urged that the soil of the vineyards be kept loosely cultivated and banked slightly toward the rows, thus covering the roots more deeply with light soil that will not crack, and so tend to prevent the larvæ from reaching the roots.

The San José scale, F. H. HILLMAN (*Nevada Sta. Bul. 29, pp. 8, figs. 4*).—This is a short popular bulletin giving the main facts in regard to the life history of *Aspidiotus perniciosus*, and describing its various stages. The pest has made its appearance in and about the town of Reno, where it affects apple, plum, and prune trees and rosebushes.

The washes usually applied are recommended for the treatment of the pest, although no formula has yet been selected as giving best results at this locality. The earnest attention of fruit growers is called to the pest and their aid solicited in arresting its progress.

The peach tree and its parasites, G. McCarthy (*North Carolina Sta. Bul. 120, pp. 284–308, figs. 22*).—This bulletin is of a popular nature. Directions for the use of insecticidal apparatus and formulas for the preparation of various insecticides are given. Descriptive, life-history, and remedial notes are given on the root borer, curculio, May beetles, rose beetle, peach tree aphis, periodical cicada, soft scale, West Indian peach scale, San José scale, and nematode worms. Peach yellows, brown rot, peach scab or mildew, peach leaf curl, shot-hole fungus, and root rot or pourridié are described and remedies suggested. The New York law in regard to yellows, black knot, and San José scale is quoted as suggestions for a law to be adopted in North Carolina. A list of the varieties recommended by the State Horticultural Society is appended.

Fruit pests, F. L. Washburn (*Oregon Sta. Bul. 38, pp. 27, figs. 14*).—The use of combined insecticides and fungicides for spraying produced satisfactory results, and a combination of Paris green and Bordeaux mixture is recommended, early applications to be made for the purpose of destroying fungus spores and young larval insects. Formulas are given for lime, sulphur, and salt wash, and for Bordeaux mixture. Descriptive notes are given for the codling moth, San José scale, woolly aphis, oyster-shell bark louse, flat-headed apple borer, apple aphis, tent caterpillar, corythuca, climbing cutworm, red spider, scolytid borers, cicada, red-humped apple caterpillar, pocket gopher, and "digger squirrel." Annotated lists are given of insects attacking the pear, prune, plum, peach, cherry, and grape.

An entomological calendar is included showing the treatment to be given orchards during each month of the year.

Brief notes are given on the following beneficial and parasitic insects: Ground beetles, tiger beetles, *Podabrus comes*, lady beetles, syrphus flies, lace-wing fly, ant lion, ichneumon flies, and tachina flies. It is urged that almost without exception birds are beneficial to horticulturists through the destruction of the injurious insects upon which they feed.

Report of the entomologist, G. H. Perkins (*Vermont Sta. Rpt. 1894, pp. 119–135, figs. 10*).—This report consists of notes on a number of insects studied during the year, and is prefaced by some general remarks upon economic entomology and the importance of more extended knowledge of insects among farmers. Directions are given for preparing and applying the more common insecticides. Under the heading of household pests remarks are made on the life history and treatment of *Dermestes lardarius*, red-legged ham beetle (*Corynetes rufipes*), ants, bedbug (*Acanthia lectularia*), flea, house fly, and mosquito. The pea weevil (*Bruchus pisi*) and the bean weevil (*B. obtectus*) are noted, and fumigation with bisulphid of carbon advised. Descriptive, life history,

and remedial notes are given on some currant worms, the following species being treated: Currant borer (*Sesia tipuliformis*), common currant worm (*Diastictus ribearia*), imported sawfly (*Nematus ventricosus*), native sawfly (*Pristiphora grossultariæ*), measuring worm (*Biston cognitaria*), and progne butterfly (*Polygonia progne*).

The phosphorescent organs of insects, A. S. PACKARD (*Jour. N. Y. Ent. Soc., 4 (1896), No. 2, pp. 61–66, fig. 1*).—Histological, physiological, and physical notes. In the common European firefly (*Luciola*) the light is polychromatic under the spectroscope, and is probably produced by an oxidation in the trachea of luminous matter secreted by the parenchyma cells.

Monograph of the order Thysanoptera, H. UZEL (*Königratz, 1895, pp. 431*).

An analytical key to the genera of the family Formicidæ, for the determination of the neuters, C. EMERY (*Ann. Soc. Ent. Belgique, 40 (1896), No. 5, pp. 172–189*).

Food habits of North American Cerambycidæ, W. BEUTENMILLER (*Jour. N. Y. Ent. Soc., 4 (1896), No. 2, pp. 73–81*).

On the habits of the larva of Zeuzera pyrina, or Z. æsculi, G. A. PONJADE (*Bul. Soc. Ent. France, 1896, pp. 189, 190*).

The æstivation of a beetle, K. SAJO (*Illus. Wochenschr. Ent., 1 (1896), No. 6, pp. 87–89*).—Notes on the summer resting period of *Entomoscelis adonidis*.

Accelerated development of silkworm eggs, M. BELLATI and E. QUAJAT (*Arch. Ital. biol., 25 (1896), No. 2*).—Notes on hastened maturity under various treatments.

An accidental thysanurous parasite of man, FRÊCHE and L. BEILLE (*Compt. Rend., 123 (1896), No. 1, pp. 70–71*).—A brief note on numerous individuals of a thysanure, probably *Seira domestica*, infesting the hairy portions of a sailor's body for 5 successive years.

The red weevil ravages in alfalfa and beet fields, M. HOLLRUNG (*Landw. Wochenbl. Schles. Holst., 46 (1896), No. 26, pp. 397–399*).—Notes on *Otiorhynchus ligustici*.

The life history of the cutworm Noctua vestigialis, K. ECKSTEIN (*Ztschr. Forst. und Jadgw., 28 (1896), No. 4, pp. 203–211*).

The yellow stalk fly (*Deut. landw. Presse, 23 (1896), No. 41, p. 361, figs. 5*).—Illustrated description of *Chlorops tæniopus*, with suggestions for remedial measures.

Saving corn from the bollworm, R. H. PRICE (*Amer. Gard., 17 (1896), No. 83, p. 468, fig. 1*).—A brief note advocating the clipping of the ends of the young ears as soon as the worms hatch.

Entomoscelis adonidis and E. sacra, K. SAJO (*Illus. Wochenschr. Ent., 1 (1896), No. 8, pp. 117–120*).—Notes on the life history of these species and their damaging rape fields in Hungary.

Notes on Pegomyia hyoscyami parasitic on sugar beets, R. CHEVREL (*Bul. Linn. Soc. Normandie, ser. 4, 8, pp. 331–340; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, p. 175*).

Life history and treatment of the sugar cane borer, J. ZEHNTNER (*Med. Proef. Sta. East Java, No. 23, n. ser., pp. 21, pls. 2*).—Life history of *Diatræa striatalis* and its hymenopterous parasites.

Damage to the Java sugar industry by Rhynchotes, G. BREDDIS (*Deut. Ent. Ztschr., 1896, No. 1, pp. 105–110*).—Descriptions of the Heteroptera and Homoptera injurious to sugar cane in Java.

The codling moth (*Gard. Chron., ser. 3, 20 (1896), No. 497, p. 11, figs. 4*).

Diagnosis of new scale insects, A. BERLESE and G. LEONARDI (*Riv. pat. veg., 4 (1896), No. 7–12, pp. 345–352, figs. 5*).

Some insects injurious to the apple, G. QUINN (*Garden and Field, 22 (1896), No. 1, pp. 24, 25*).—The codling moth, native apple moth (*Cacœcia verpousa*), woolly aphis, apple mussel scale (*Mytilaspis pomorum*), harlequin fruit bug (*Dindymus versicolor*), curculio beetle (*Otiorhynchus sulcatus*), and apple root borer (*Sotops hopei*) are described and treatment suggested.

The strawberry leaf roller, J. CRAIG (*Canadian Hort., 19 (1896), No. 7, pp. 240,*

241).—Notes on this insect which has been injurious in Ontario. Mowing and burning over the strawberry fields after gathering the crop is recommended.

Another enemy of the vine—the coccus of Chile, V. MAYET (*Agl. Jour. Cape Colony, 9 (1896), No. 7, pp. 158–161*).—A summary of the life history of *Margarodes vitium*, mentioning the damage done by it in the Argentine Republic.

Destruction of oak branches by beetles and their treatment, ALTUM (*Ztschr. Forst. und Jagdw., 28 (1896), No. 2, pp. 141–154, fig. 1*).—Notes are given on *Peritelus hirticornis*, *Strophosomus obesus*, *S. coryli*, and *Polydrusus micans*, and means suggested for their destruction.

The oak pruner (*Garden and Forest, 9 (1896), No. 439, p. 297*).—Notes are given of *Stenocorus putator*, which is very destructive to oaks in some regions.

Forest insects—some gall-making coccids, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 4, pp. 209–218*).—Notes on the Brachyscelidæ, with descriptions of several new species.

White ants as tea pests, G. WATT (*Indian Agr., 21 (1896), No. 6, pp. 177–180*).

Notes on Trigonogenicus farctus, E. A. SCHWARZ (*Canadian Ent., 28 (1896), No. 7, pp. 177, 178*).—This species was found in red pepper in British Columbia.

Flowers and insects, C. ROBERTSON (*Trans. Acad. Sci. St. Louis, 7 (1896), No. 6, pp. 151–179*).—This, as a sub-title states, consists of contributions to an account of the ecological relations of the entomophilous flora and anthophilous insect fauna of the neighborhood of Carlinsville, Illinois.

Conorhinus sanguisugus, its habits and life history, B. S. KIMBALL (*Trans. Kansas Acad. Sci. 1894, pp. 128–131*).

Injuries through necessity, K. SAJO (*Illus. Wochenschr. Ent., 1 (1896), No. 13, pp. 202–205*).—This treats of insects attacking cultivated plants because of the extermination of their wild food plants.

The combating of cutworms, FRANK (*Deut. landw. Presse, 23 (1896), No. 57, p. 507, fig. 1*).—Advocates the use of lanterns for trapping the moths.

Proceedings in coping with the grub pest, H. TRYON (*Sugar Jour. and Trop. Cult., 5 (1896), No. 4, pp. 91–93*).—Remedies proposed for the sugar cane grub (Distræa) in Queensland. Carbon bisulphid is suggested.

Experiments with insecticides against Cochylis ambiguella, A. BERLESE and G. LEONARDI (*Riv. pat. Veg., 4 (1896), Nos. 7–12, pp. 304–343*).

The combating of the May beetle, FEDDERSEN (*Ztschr. Forst. und Jagdw., 28 (1896), No. 5, pp. 265–318*).

Calcium carbid as an insecticide (*L'Engrais, 11 (1896), No. 27, p. 638*).

"Raupenleim" and "Dendrolene," J. B. SMITH (*Ent. News, 7 (1896), No. 6, p. 177*).—Notes on the effects of these substances on young trees. Dendrolene was found to kill the borers in the trees. The outer bark of peach trees was discolored and killed, but no serious injury done, and it is believed that no harm will result if the material be scraped off in late summer.

Descriptions of new parasitic Hymenoptera, W. H. ASHMEAD (*Trans. Amer. Ent. Soc., 23 (1896), pp. 179–234*).

Predaceous and parasitic enemies of aphides, V, H. C. A. VINE (*Internat. Jour. Micros. and Nat. Sci., ser. 3, 6 (1896), No. 31, pp. 249–263, pls. 2*).

FOODS—ANIMAL PRODUCTION.

The minimum of protein in the food required to produce nitrogen equilibrium, J. MUNK (*Verhandl. Berlin physiol. Ges., 16 (1895), No. 11; Centbl. Physiol., 9 (1896), pp. 723, 724*).—A dog weighing 25 kg. was made to fast 6 days. The nitrogen excreted daily in the urine was 6.1 gm. and in the feces 0.3 gm. The animal was fed 100 gm. of meat and 75 gm. of fat daily. On the first day 200 gm. of rice

was fed also, the amount being increased until on the sixth day the animal received 250 gm. On the fifth day the animal was in nitrogen equilibrium. On the sixth and seventh days 4.65 gm. of nitrogen was excreted in the urine and 0.86 gm. in the feces, about three times as much as in hunger. Undigested rice could be identified in the feces. The nitrogen required was only sixth-sevenths of that excreted during hunger.

The author concludes that when a large amount of carbohydrates and little protein and fat are fed the protein consumption sinks far under the typical hunger minimum.

The formation of fat from protein in the animal body, M. KUMAGAWA and G. KANEDA (*Mitt. med. Fac. d. k. Jap. Univ., Tokio, 3 (1895), No. 1, p. 11; Centbl. Physiol., 9 (1896), pp. 721–723; abs. in Chem. Centbl., 1896, I, No. 13, p. 719*).—Two dogs of the same litter were made to fast for 24 days. The nitrogen in the urine was determined daily. One dog was then killed and the fat in all the organs determined. This dog weighed 11.55 kg. at the beginning of the fasting period and had lost 82.88 gm. in weight. The total nitrogen in the flesh of the animal was 519 gm. and the total ether extract 145.5.

The second dog weighed 9.04 kg. at the beginning of the fasting period and at the end 6.08 kg. It was calculated that the fat content of this dog was 120 gm. The dog was fed meat for 50 days, the ether extract, glycogen, nitrogen, and water in the meat being determined, and the nitrogen in the urine and feces. The dog was killed and the flesh analyzed. It was found that he had gained 1,087.7 gm. of fat and had consumed practically the same quantity, 1,084.4 gm. (The glycogen of the meat consumed was reduced to fat in the computation.)

From this experiment the authors conclude that the animal organism can not build fat from protein. The nitrogen consumed was considerably greater than the amount excreted in the urine and feces. Adding to this latter quantity the amount which was gained in the form of muscular tissue there still remained an excess of nitrogen which the authors can not account for.

A practical experiment in the study of dietaries, M. TALBOT (*Review of Reviews, 13 (1896), No. 3, pp. 300–302*).—A brief account is given of a dietary investigation made at the Women's Halls of the University of Chicago. The composition of the food was calculated from standard tables.

The food purchased, the cost of food, and the nutrients consumed per person per day in 1894 and 1895 are shown in the following table:

Total amount purchased and cost, with nutrients and nutritive value of food consumed per person per day.

Year.	Food purchased.	Cost.	Protein.	Fat.	Carbohydrates.	Calories.
	Pounds.		*Grams.*	*Grams.*	*Grams.*	
1894	5.00	$0.250	121	121	381	3,183
1895	5.33	.241	115	122	408	3,279

"During the time covered by the investigation the income received from persons paying board at the rate of \$3.50 per week was only sufficiently large to permit of an allowance of 25 cts. for raw food material per day per person, including the large staff of servants."

Chinese soja bean preparations, H. C. P. GEERLIGS (*Chem. Ztg., 20 (1896), No. 9, pp. 67–69*).—The author describes in detail the process of manufacture of Chinese bean cheese (*tao-hu*), soja sauce (*tao yu*), and *tao tjiung*, which is very similar to Japanese *miso*. Analyses of these products are given, also of Javanese and Chinese soja beans and of the pods of the black variety of soja beans. The author discusses at length the importance of fungi in the manufacture of soja bean products, and describes briefly a similar use of fungi in Java in preparing a food from peanut cake. The fungi change starch and pectin substances into sugar, and also break up cell walls, rendering the contents more available.

"**Nutriotone," a condimental food**, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 150, 151*).—The trial of this material was made away from the station and not under its auspices, but "under such circumstances as cause it to be entirely trustworthy."

Seven Jersey cows were fed a daily ration of 15 lbs. of hay, 3 lbs. each of bran and corn, 2 lbs. each of oats and gluten meal, and 1 lb. of malt sprouts during 5 two-week periods. During the third and fifth periods 2 tablespoonfuls of the "Nutriotone," the amount prescribed, were added to the ration of each cow daily. The yields of milk and the percentages of fat are given. The material costs from \$250 to \$500 per ton, according to the amount purchased.

"The circular of the maker states that if 2 tablespoonfuls are mixed with each grain feed the user 'will be agreeably surprised at the increased quantity and improved quality of milk . . . and productiveness of the animals.'

"The material does not appear to have increased production in this particular experiment."

Four ways of preserving fodder corn, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 168–192*).

Synopsis.—The four methods used were as follows: (1) The whole plant cut up and ensiled; (2) the stover ensiled, the corn being removed and afterwards ground and fed with the silage; (3) the whole plant stooked in the open air and cut and fed as needed; and (4) the stover stooked in the open air, the corn being removed and afterwards ground and fed with the stover. The loss of dry matter was practically the same by the four methods, namely, about one-fifth of that harvested, the losses falling mainly upon the carbohydrates. "The ears in the silo lost more of their food value than those handled in other ways." Cows relished the silage better than the dry fodder. There was little difference in the product of milk and butter on the two kinds of silage, although the results slightly favored the whole silage as regards the amount of milk and butter produced per pound of dry matter fed.

This is a repetition of 2 experiments previously reported (E. S. R., 5, p. 312). In the fall of 1894 the corn (a mixture of Sanford and Red Cob) harvested at the station was treated in the following manner: That from the first 2 rows was cut in ½-inch pieces, ears and all, and

ensiled ("whole silage"); from the next 2 rows the ears were picked off, husked, and ground, and the stover and husks were ensiled, the silage and corn meal being afterwards fed together ("stover silage and meal"); from the next 2 rows the corn was stooked near the barn and cut up as wanted for feeding, ears and all ("corn fodder"); and that from the fourth 2 rows was stooked near the barn, the ears picked off, a little later husked and ground, and the stover cut up as needed and fed with the corn meal ("corn stover and meal"). This plan was followed throughout the entire field. The corn crop was thus divided into 4 equal parts, 2 parts of which were ensiled and the other 2 parts field cured, the ears from one part in each case being cut up with the stalks and from the other part ground and fed with the respective corn fodder or silage.

The percentage of loss in preserving corn by each of the 4 methods is summarized below:

Percentage of losses in preserving corn fodder in different ways.

Method of preservation.	Dry matter.	Crude ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Phosphoric acid.	Potash.
Whole silage	20	+3	12	5	30	16	18	+
Stover silage and meal	18	+3	6	5	27	11	7	8
Corn fodder	20	1	12	+3	31	26	16	8
Corn stover and meal	20	6	10	2	29	21	6	16
Average	20	0	10	2	29	19	12	8

"Notwithstanding the very different methods of handling, the losses are essentially the same in kind and degree, falling mainly upon the carbohydrates (starch, sugar, etc.).

"The character of the losses is similar to those found in the 2 experiments previously reported. . . . There is a close relation between the losses of weight and of dry matter in the silages. . . .

"The experiment of 2 years ago showed an average of 25 lbs. dry matter lost for each 100 lbs. of loss in weight, average percentage loss of weight and dry matter of 15.8 and 18.7, while the averages of 8 experiments at the Wisconsin Station show 19 per cent loss in both weight and dry matter. It would appear from these figures that, roughly, a fourth of the gross loss in the silo is dry matter, and that the percentage loss of dry matter usually exceeds that of the entire weight. . . .

"There appears to have been much greater losses with the ears put into the silo than with those which were husked, the reverse of the results 2 years ago, when the losses were 15 per cent with the ensiled and 23 per cent with the stooked ears. The stover silage ears of 1892, however, were exposed for several days to heavy rains, which probably accounts for their large losses. . . .

"The ears of the other 2 parts lost but little in feeding value. The showing is not favorable to the ensiled ears."

A feeding experiment to test the corn preserved in the different ways was made with 14 cows. One lot was fed alternately on the 2 kinds of silage for 5 four-week periods, and lot 2 on the 2 kinds of dry fodder for the same time.

As explained above, the corn meal from the ears which had been picked off were fed with the stover or silage to which they belonged.

In addition each cow received 10 lbs. of hay, 4 lbs. of wheat bran, and 4 lbs. of corn meal daily.

The data for the feeding trials are given in detail and summarized. "A large proportion of the cows under experiment ate too little of the dry fodder in comparison with the other materials fed to admit of safe conclusions being drawn."

The yields of milk, etc., on the two kinds of silage are given below.

Yields of milk, etc., on two kinds of silage.

	Milk.	Total solids.	Fat.	Solids-not-fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Whole silage	5,403	754	257	497
Stover silage and meal	5,440	757	257	500

"Had the cows been fed precisely alike the results could have hardly been closer. The butter yields are identical, and there is but one-half of 1 per cent difference in the milk yields."

The production of milk, total solids, and fat from the whole silage was notably larger than from the stover silage and meal, which was also the case in the experiment the year before.

Following is the author's summary of the investigations:

"(1) Each of the 4 methods of preservation saved about four-fifths of the dry matter as harvested, and, judged by this alone, they were of practically equal efficiency, the figures being: Stover silage and meal, 18 per cent loss of dry matter; whole silage, corn fodder, and corn stover and meal, 20 per cent loss of dry matter each. These figures are almost identical with those obtained in similar tests previously made at this station.

"(2) The character of the losses in food ingredients is much the same in each case, there being little or no loss of crude ash or crude fiber, a shortage of about a tenth each of the crude protein, phosphoric acid, and potash, while ether extract and nitrogen-free extract lose, respectively, two-tenths and three-tenths of the amount present at harvest.

"(3) The stooked fodders, while stooked, lost more and more dry matter as the winter went on. After cutting they lost considerable dry matter, but less as the winter grew longer.

"(4) The losses in gross weight and dry matter in the silos were found to be parallel, the latter, however, exceeding the former.

"(5) The ears in the silo lost more of their food value than those handled in other ways, the reverse of the result in the 1892–'93 experiment.

"(6) The relative cost of placing the same amount of dry matter in the manger was greatly in favor of the whole silage. The time and money spent in husking and grinding the ears were wasted, since better results were obtained when the ears were left on the stalk.

"(7) In this experiment the silages were relished much better than the dry fodders, and the cows did better upon them.

"(8) The same quantities of milk and butter were made by feeding whole silage and stover silage and meal; the milk was not changed in quality, but the cows ate less dry matter from whole silage to produce the same amounts of milk and butter.

"(9) There were but 91 or 92 lbs. of milk and butter produced by a given amount of dry matter in the stover silage and meal ration to 100 lbs. produced by the same amount of dry matter in the whole silage ration.

"(10) The whole silage lasted longest, and would consequently make the most milk and butter. An acre of corn made into whole silage yielded as much as 1.095 acres made into stover silage.

"(11) The results of this experiment as a whole are in entire accord with those obtained in the similar trial at this station in 1892-'93 (E. S. R., 5, p. 312)."

Experiments in feeding for beef, C. E. THORNE and J. F. HICKMAN (*Ohio Sta. Bul. 60, pp. 56, dgms. 3*).

Synopsis.—Two sets of experiments (in 1894 and 1895) with mixed breeds were made to determine the cost of producing beef and to test the relative feeding value of corn meal and wheat meal, gluten meal and linseed meal, corn silage as part of a ration, and corn silage and corn stover. Data were also recorded relating to heavy and light feeding, finishing beeves on grass, warm barns *vs.* open sheds, effect of temperature, and value of manure. Tentative conclusions only were drawn. The chemistry of cattle feeding and the comparative value of various feeding stuffs are also discussed with reference to the experiments.

The steers, 32 in number, for the first experiment were purchased in the neighborhood and were grades of mixed breeding. They were pastured during the summer and fall and were then divided into 7 lots of 4 steers each and 2 lots (8 and 9) of 2 steers each. The experiment began January 11, 1894, and continued 120 days. The rations fed each lot were as follows:

Lot 1. 3 parts corn meal, 3 wheat bran, 2 gluten meal, clover hay.
2. 3 parts corn meal, 3 wheat bran, 2 gluten meal, clover hay, and silage.
3. 3 parts corn meal, 3 wheat bran, 2 linseed meal, clover hay.
4. 3 parts corn meal, 3 wheat bran, 2 linseed meal, clover hay, and silage.
5. 3 parts wheat meal, 3 wheat bran, 2 gluten meal, clover hay, and silage.
6. 3 parts wheat meal, 3 wheat bran, 2 linseed meal, clover hay, and silage.
7. 3 parts corn meal, 3 wheat bran, timothy hay, and silage.
8. 3 parts corn meal, 3 wheat bran, timothy hay, and silage.
9. 3 parts corn meal, 3 wheat bran, timothy hay, and silage.

The linseed meal was old-process meal. The steers were given all they would eat. All but lot 9 were fed in the barn. This lot was fed in an open shed in the yard.

The financial statements are based on the following prices: Corn meal, \$16; wheat meal, \$20; gluten meal, \$18; linseed meal, \$26; wheat bran, \$16; clover, \$8, and corn silage \$2.50 per ton.

The average amount of grain eaten per steer daily during the later part of the experiment was 15 or 16 lbs. on the corn-meal mixture and about 12 lbs. on the wheat meal.

The average results for each lot are summarized in the following table:

Result of feeding experiment with steers in 1894.

Lot.	Grain (in addition to wheat bran).	Weight at beginning of test.	Total gain.	Feed consumed.			Dry matter consumed per pound of gain.	Cost of feed.	
				Grain.	Hay.	Corn silage.		Total.	Per pound of gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*		*Cents.*
1	Corn meal and gluten meal (*a*)	1,019	279	1,783	1,249	....	9.73	$19.66	7.05
2	.....do	980	258	1,627	443	3,188	10.16	19.13	7.42
3	Corn meal and linseed meal (*a*)	981	209	1,783	1,100	....	12.36	20.63	9.88
4	.....do	966	239	1,529	365	3,374	10.47	19.00	8.20
5	Wheat meal and gluten meal	936	212	1,226	453	2,859	10.40	16.42	7.77
6	Wheat meal and linseed meal	960	255	1,358	505	3,447	9.78	19.80	7.74
7	Corn meal and timothy hay	995	231	1,628	327	3,397	10.78	18.27	7.90
8 & 9	.....do	842	245	1,639	317	2,416	9.46	17.40	7.11

a Without corn silage.

At the conclusion of the experiment the steers were sold and slaughtered.

The price received was $4.70 per 100 lbs., "which netted $4.50 per 100 lbs. at the station, making their value at the end of the 120 days under review $1,677.64. The total cost of the feed consumed was $587."

For the second experiment 16 steers of similar breeding to those used in the first experiment were purchased. After grazing during the summer and fall they were divided into 3 lots of 4 and 2 lots of 2 steers each. The experiment lasted from January 11 to April 30, 1895, 110 days. All the steers were fed wheat bran, hay, and silage or stover. In addition, lots 1 and 2 were fed wheat meal and gluten meal, lot 3 corn meal and gluten meal, and lots 4 and 5 corn meal. Less grain was fed than in the first experiment and there were fewer cases of surfeit.

Lot 5 was fed in an open shed in the yard. The other lots were fed in the barn.

The financial statements are based on the same data as in the first experiment, with the addition of corn stover at $3 per ton.

The average results for each lot are summarized in the following table:

Result of feeding experiment with steers in 1895.

Lot.	Ration (in addition to wheat bran and hay).	Weight at beginning of test.	Total gain.	Feed consumed.			Dry matter consumed per pound of gain.	Cost of feed per pound of gain.
				Grain.	Hay.	Silage.		
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
1	Wheat meal, gluten meal, and silage	1,003	187	1,240	596	2,558	11.78	8.95
2	Wheat meal, gluten meal, and stover	1,009	176	1,262	943	*a* 394	13.64	8.93
3	Corn meal, gluten meal, and silage	954	222	1,232	671	2,250	9.90	7.01
4 & 5	Corn meal and silage	994	226	1,256	871	2,555	11.07	7.40

a Stover.

At the conclusion of the experiment the steers were sold and slaughtered. The price received was $5 per 100 lbs., "netting $4.77 per 100 lbs. at the station, or a total value of $910.64 at the end of the 110 days." The total cost of feed consumed was $647.72.

The various points under consideration are discussed and the two experiments are compared in detail. A brief summary of the discussion is given below:

Corn meal vs. wheat meal.—The average daily gain per animal in 1894 of lots 2 and 4 on corn meal was 2.07 lbs., and lots 5 and 6 on wheat meal, 1.98 lbs.; in 1895 it was 2.02 lbs. for lot 3 on corn meal, and 1.70 for lot 1 on wheat meal. The results are contradictory.

Linseed meal vs. gluten meal.—In 1894 the average daily gain per animal of lots 3, 4, and 6 on linseed meal was 1.96 lbs. and of lots 1, 2, and 5 on gluten meal 2.11 lbs. In the author's opinion this would "warrant the statement that for the fattening of cattle these feeding stuffs are approximately of equal value pound for pound and that the one which can be bought for least money is the one to use."

In 1894 lot 2, on mixed grain (corn meal and bran), with gluten meal, made an average daily gain per animal of 2.15 lbs., and lots 7, 8, and 9 on mixed grain, without gluten meal, 1.98 lbs. In 1895 the average daily gain per animal of lot 3 on mixed grain, with gluten meal, was 2.02 lbs., and of lots 4 and 5 on mixed grain, without gluten meal, 2.05 lbs.

The results were in favor of gluten meal.

Corn silage as part of a ration, and corn silage vs. corn stover.—In 1894 lots 2 and 4, with silage, made an average daily gain per animal of 2.07 lbs., and lots 1 and 3, without silage, 2.03 lbs. In 1895 lot 1, on a ration with silage, made an average daily gain per animal of 1.70 lbs., and lot 2, on stover, of 1.60 lbs. The slight difference was in favor of silage. The author reviews briefly the comparison of corn silage and stover at other stations, and makes the following deductions:

"The logical conclusion of all this work is that the process of ensiling adds nothing to the nutritive value of a feeding stuff. It does add to its palatability, however, when the method has been properly employed, and in consequence a larger proportion of the fodder will be consumed. In regard to the cost of this method, we do not consider it any greater than that of the ordinary method of cutting and husking and stacking the stover, and not so great as cutting, husking, and stacking and grinding the grain, and certainly all this must be done if the food materials are to be as thoroughly preserved and made as completely available as they are in well cured silage."

Finishing beeves on grass.—During the last 2 weeks of each experiment half of the cattle were turned out to grass during the day, and stabled at night. The others remained in the barn all the time. The average daily gain per animal in 1894 was 1.42 lbs. at pasture and 2 lbs. in the barn; in 1895 it was 1.37 lbs. at pasture and 1.76 lbs. in the barn. The best gains were made by the steers kept in the barn.

Warm barns vs. open sheds.—In each experiment 2 steers were fed

in an open yard with a shed. The average daily gain per animal was 1.93 lbs. The other steers were fed in a warm barn and averaged 1.99 lbs. per day. No conclusion is drawn.

Careful records of the temperature during each test were kept and the variations shown by diagrams. No conclusions were drawn.

The best gains were made when heavy feeding (all the animals would eat without surfeit) was followed.

The steers made a more rapid gain during the first part of the fattening period than later.

The principles of feeding and the value of the manure are discussed at considerable length and analyses quoted.

Using the available data, the digestible nutrients and the fuel value of the food consumed per pound of gain and the nutritive ratio of the rations are computed and tabulated. The digestible nutrients consumed daily by the average steer were as follows: Total dry matter, 21.2 lbs.; protein, 2.13 lbs.; carbohydrates, 11 lbs.; fat, 0.75 lb.

Pig feeding, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 86–92*).

Synopsis.—The questions studied were the comparative value of watery and concentrated rations, the effect of these rations upon shrinkage and dressing, the relative feeding value of skim milk and buttermilk, and a comparison of Poland-China, Yorkshire, and Berkshire breeds.

These experiments were in continuation of those reported in previous years (E. S. R., 6, p. 317; 7, p. 929).

The tests were made with 10 pigs purchased in the vicinity of the station. Nos. 1 and 4 were Poland-Chinas, Nos. 2, 5, 8, and 10 Berkshires, and Nos. 3, 6, 7, and 9 Yorkshires. Owing to errors in the records the results obtained for Nos. 3 and 6 were omitted in the author's summary.

For 3 weeks before the trial began the pigs were fed skim milk *ad libitum*. The experiment began June 1 and lasted until November 15–28. The pigs were 4 weeks old at the beginning of the test. The test with Nos. 1, 2, 4, and 5 was divided into 4 periods of 20, 56, 48, and 44 days; with Nos. 7, 8, 9, and 10 into periods of 30, 46, 51, and 41 days. Nos. 1 and 2 were fed at first 2 oz. of corn meal to 1 qt. of skim milk daily, and later corn meal and half bran *ad libitum*. When they weighed about 200 lbs. they were finished off with skim milk and corn meal *ad libitum*. Nos. 7 and 8 were fed the same general ration; also Nos. 9 and 10, except that 7 qts. of buttermilk were substituted for 6 qts. of skim milk. Nos. 4 and 5 were fed skim milk alone in increasing amounts until they consumed 9 qts. daily, then 1 oz. of corn meal to 1 qt. of milk was added until 12 oz. were taken daily. The amount of meal was then doubled, and after a time half bran and corn meal in increasing proportions were fed.

The financial statements are based on corn meal and bran at $20 and $18 per ton, respectively; skim milk at 15 cts. per 100 lbs., and buttermilk at 13 cts. per 100 lbs. At the end of the experiment the pigs were slaughtered and sold for 7 cts. per pound, dressed weight.

Tables are given which show the food consumed and the gains made by each pig during each period, the difference between the live weight and dressed weight, food consumed per pound of gain, and the profit obtained. These data are summarized for the whole period in the following table:

Summary of results of pig-feeding experiment.

Number of pig.	Food consumed.				Weight at beginning.	Gain in live weight.	Dry matter eaten per pound of gain.	Shrinkage in dressing.	Profit per pig.
	Skim milk.	Buttermilk.	Corn meal.	Bran and corn.					
	Quarts.	*Quarts.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	1,008	....	221	359	41	216	3.26	42	$3.87
2	1,008	....	221	347	37	213	3.27	40	3.75
4	1,724	....	152	41	35	181	2.87	36	3.37
5	1,724	....	152	41	29	180	2.88	42	3.28
7	1,008	....	186	234	27	183	3.07	33	3.73
8	1,008	....	211	249	32	208	2.89	42	4.37
9	....	1,176	211	249	26	195	3.19	39	3.93
10	....	1,176	211	256	27	211	2.98	42	4.44

Nos. 1, 2, 7, and 8 were compared with Nos. 4 and 5 to determine the relative value of concentrated and watery foods. "The cost of food for a pound of increase in live weight and the profits were slightly in favor of the less watery ration. The shrinkages were identical by both methods of feeding."

Nos. 1, 2, 7, and 8 were compared with Nos. 9 and 10 to show the relative value of skim milk and buttermilk. "The buttermilk had about four-fifths the feeding value of skim milk."

Nos. 1 and 4 (Poland-China) were compared with Nos. 2, 5, 8, and 10 (Berkshire) and Nos. 7 and 9 (Yorkshire). "The Poland-Chinas and Berkshires gave the same results. In another test Berkshires outstripped the Yorkshires." In each comparison the average live weight, dressed weight, percentage of shrinkage, dry matter eaten per pound of gain, live and dressed weight, cost of food per pound of gain in dressed weight, and the total gain per pig are shown in tabular form.

The author discusses the proper time to market pork, and calls attention to the fact that after a time it costs more to keep pigs than the gain is worth. He computes that the fertilizing value of the food eaten was $38.93, or 62 per cent of the market value of the food, provided the manure was properly handled.

Report on feeding experiments with pigs in 1895 at the Dairy Institute in Proskau (*Molk. Ztg., 10* (*1896*), *Nos. 1, pp. 2–5; 2, pp. 18, 19; 3, pp. 67, 68*).

Synopsis.—The following questions were discussed: (1) The value of corn as a fattening food for young pigs, (2) influence of different methods of preparing the corn, (3) the value of whey instead of potatoes for a ration, and (4) the value of brewers' grains instead of corn.

It was found in previous experiments, reported in 1894 (E. S. R., 6, p. 77), that feeding a great amount of corn did not give good results with pigs under 6 months old, since the animals fattened too rapidly and did

not form good bones. The present experiments were made to determine whether the bad effects were due to feeding corn or to feeding too much of it.

Four lots of 2 pigs each, all from the same litter, were used. They were crosses of English and Meisen breeds. Two preliminary tests were made. In the first the pigs, which were 6 weeks old, were fed for 28 days 560 kg. of skim milk and 44.8 kg. of barley meal. They were fed 5 times daily. The total gain of the lot was 50.5 kg. In the second preliminary experiment of 6 weeks the rations were gradually changed from skim milk and barley meal to the rations fed in the test. During this time lots 1 and 2 gained 30.75 kg.; lot 3, 27 kg.; lot 4, 29.50 kg. The feeding experiment proper covered 3 periods of 6 weeks each, and the following rations were fed:

Lot 1. Skim milk, cooked corn meal, and potatoes.
Lot 2. Skim milk, uncooked corn meal, and potatoes.
Lot 3. Skim milk, cooked corn meal, and whey.
Lot 4. Skim milk, brewers' grains, potatoes, and whey.

The gains made during the experiment and the food consumed per kilogram of gain for each lot are shown in the following table:

Gain made and food consumed per kilogram of gain.

Lot.	Weight at beginning.	Gain during period.	Food consumed per kilogram of gain.				
			Skim milk.	Corn.	Brewers' grains.	Potatoes.	Whey.
	Kg.	*Kg.*	*Kg.*	*Kg.*	*Kg.*	*Kg.*	*Kg.*
1	63.25	127.75	7.9	1.64	....	3.78	....
2	59.75	134.00	7.5	1.57	....	3.60	....
3	57.00	120.00	8.4	1.75	....	....	12.10
4	58.50	117.25	2.5	....	1.79	7.16	2.15

The animals were slaughtered and the dressed weight of each pig, its relation to the live weight, and the amount of belly fat and thickness of the bacon fat on the back were determined.

In these experiments the following conclusions were drawn: Feeding corn meal was followed by good results in every case. Corn meal may be fed to pigs under 4 months old with no bad results, provided the amount fed be not too great at first, but gradually increased, and the whole ration not too rich. It was found that the animals fed uncooked corn meal made a slightly larger gain than those fed cooked corn meal. As in the previous year, whey was found to give good results. The lot fed brewers' grains made less gain than the lots fed corn, but the experimental data are not considered sufficient to warrant a general conclusion.

On the yield of flour from wheat and on whole meal bread, BALLAND (*Compt. Rend., 122 (1896), No. 1, pp. 46–49; Monit. Indust., 23 (1896), No. 5, pp. 69, 70*).—The flours obtained by several processes of grinding, both ancient and modern, are compared as to composition. The flour obtained by the process of grinding in use among Romans was quite similar to that obtained in the present method of grinding flour

for the French soldiers. Bread from fine wheat flour and whole wheat meal is discussed, and the latter recommended as preferable.

The meat obtained from tuberculous animals as food, H. RAQUET (*Ann. Sci. Agron., ser. 2, 2 (1894–'95), No. 3, pp. 340–349*).—This article is a report made to the International Congress of Agriculture at Brussels. The wholesomeness of flesh from tuberculous animals for human food is discussed; and in view of the success of the plan in other countries the Belgian Government is recommended to provide for the construction of suitable sterilizers to be used with such meat. Some experiments by Petermann, André, and Stubbe with a sterilizer devised by Wodon, which gave satisfactory results, are quoted.

Brotöl (*Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), No. 6, p. 114*).—Brotöl is a by-product in the refining of petroleum which has been recommended as a substitute for vegetable or animal fat in cooking. Experiments made with man and animals have shown that this preparation produces vomiting, digestive derangements, etc. It is therefore regarded as a harmful product.

The amount of iron in ordinary dietaries, R. H. CHITTENDEN (*Diet. and Hyg. Gaz., 12 (1896), No. 1, pp. 24–26*).—This is a résumé of an article by Stockman (*Jour. Physiol., 18, p. 484*). The amount of iron in various articles of food is given, as well as the amount in the diet of persons of different ages and occupations, 8 to 10 or 11 mg. being the amount for healthy persons with a good appetite.

Notes on hospital dietaries, E. H. RICHARDS (*Amer. Jour. Insanity, 52 (1895), No. 11, pp. 214–217*).—The author points out that the dietary suggested by A. Flint for hospital patients (insane) when computed in terms of protein, carbohydrates, and fat is much larger than the accepted standard in Germany. It is also quite expensive. The diet is compared with several other American dietaries.

Dietary of the New York State hospitals, C. H. PILGRIM (*Amer. Jour. Insanity, 52 (1895), No. 11, pp. 228–233*).—Flint's dietary for insane patients is quoted in its original and also in its revised form. The author finds by practical experience that the diet is well suited to the purpose for which it was proposed, and various suggestions regarding the preparation and serving of food in insane hospitals are given.

A study in the economy of cattle foods, G. W. SHAW (*Oregon Sta. Bul. 39, pp. 31–52*).—Terms used in feeding experiments are discussed, and analyses of several Oregon fodder plants (red clover, timothy, orchard grass, tall oat grass, cheat or chess, and oat straw) are given, as well as the calculated dry matter and digestible matter per 100 lbs.

VETERINARY SCIENCE AND PRACTICE.

An investigation of the nature, cause, and means of preventing the cornstalk disease (Toxæmia maidis) of cattle, V. A. MOORE (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 10, pp. 9–70, pls. 2*).—This article records the results of an elaborate investigation of this obscure disease from which cattle sometimes suffer when feeding in cornstalk fields in late fall and early winter. The affection is restricted in distribution to the middle and northern portion of the Mississippi Valley, where the farmers harvest their corn by picking the ears from the standing stalks, cattle then being turned into the fields. Owing to the insidiousness of the disease and the frequent failure of veterinarians and butchers to find lesions sufficient to cause death, the disease has been regarded as a most mysterious affection and almost invariably fatal. The disease has been known to exist for 40 years. Various theories as to its cause have been suggested—lack of salt and insufficient water, eating cornstalks alone, stomach impaction, ingestion of

corn smut, and the presence of the species of bacteria which causes corn blight, or Burrill disease. The first 3 theories are of popular origin and not supported by the general experience of cattle raisers.

The results of investigations previous to those undertaken by the Bureau of Animal Industry are briefly summarized, the symptoms of the disease being the chief points determined by the investigators. Experiments to determine the etiological importance of corn smut gave negative results. A circular letter of inquiry concerning the nature, distribution, and importance of the cornstalk disease was sent out in 1891 to a large number of farmers and cattle raisers, and the replies are briefly summarized.

The investigations detailed in this article were carried out with the assistance of the experiment station at Ames, Iowa, and the methods of investigation are briefly outlined. Notes are given on cattle attacked and dying in 18 outbreaks in different portions of the State, and the symptoms of the diseased animals and the results of *post-mortem* examinations are detailed.

To determine the connection of cornstalks affected with corn blight, or the Burrill disease, with the cornstalk disease, diseased cornstalks were fed exclusively to cattle which were carefelly watched for several weeks, but no evidence of disease appeared. Eight rabbits, fed upon cornstalks and leaves known to be infected with the bacillus of the Burrill disease, became emaciated, but only 2 died. The bacillus of the Burrill disease of corn is thus regarded as possessing an innocuous nature. The bacillus was isolated and pure cultures made. It was identified as *Bacillus cloacæ*. It occurs in the soil and in the stalks affected with corn blight.

Although previous experiments to test the effect of feeding corn smut to animals had given negative results, further experiments were made, cattle being fed almost exclusively on smut-laden cornstalks and free smut for several days. The animals continued perfectly well throughout the time of feeding and for several months afterwards, during which they were kept under close observation. A table is given showing the daily temperature of the animals during the feeding experiment.

Instances of cattle and sheep dying while pasturing in cornstalk fields were reported to the investigators, but there was no evidence of the existence of the cornstalk disease in horses, sheep, or swine. Cornstalks, leaves, tassels, and the liver of a steer dying from cornstalk disease were subjected to a careful chemical analysis without the presence of any alkaloidal poison or unusual quantities of inorganic salts being revealed.

A discussion of the nature of the disease, based upon data obtained in the special investigation, is given, and the conditions under which the disease occurred are elaborated in an extensive table. In general the symptoms were those of muscular weakness, merging into paralysis,

and accompanied by signs of intense agony and distress. Nervous twitchings and jerkings were frequently present. An opportunity was not afforded the investigators to observe an animal suffering from this affection prior to death, and the accounts of the symptoms are all taken from observations made by the owners. *Post-mortem* examinations revealed very slight structural changes in the various organs, the only gross pathological changes observed being those of a hemorrhagic nature, mostly confined to the serous membranes and principally those of the heart. Ecchymoses were also present beneath the pleura, over the surface of the liver and spleen, and in the mucosa of the intestinal tract. Twelve distinct species of bacteria not recognized as saprophytes were isolated, but they all proved harmless to experimental animals.

It is believed that the disease is due to the existence of a poison in the cornstalks, although the nature of this toxin has not yet been determined, and its presence is indeed but a provisional hypothesis based upon the trend of the accumulated data. It is stated that although the loss of cattle from this disease is severe, it is not of such great economic importance as has been thought, and as it *is* not contagious, does not threaten the cattle industry of this or other countries to which cattle may be shipped.

Prevention is regarded as the only practical remedy. It is recommended that cornstalks and leaves for fodder be cut, and fed to cattle after this manner, instead of the cattle being turned into the fields and allowed to feed upon the standing stalks.

The plates are from microscopic sections of liver tissue and heart muscle, showing blood engorgement and hemorrhages in the tissues.

Chemical examination of cornstalks presumably the cause of cornstalk disease in cattle, E. A. DE SCHWEINITZ (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 10, pp. 88–90*).—The results of a chemical examination of cornstalks taken from Iowa cornfields wherein cattle feeding had been affected with the cornstalk disease. The methods of analysis are stated at some length, and the reactions obtained with various reagents are set down. No reaction whatever indicating any alkaloidal content in the stalks was obtained. A diseased liver from one of the animals dying from the cornstalk disease was also extracted and analyzed, but with entirely negative results. The presence of an active poisonous principle has therefore not been demonstrated.

A disease in cattle not distinguishable from rabies, V. A. MOORE (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 10, pp. 71–87*).—This recounts the results of investigations of a peculiar disease affecting cattle in Iowa in 1892. The disease made its appearance among a herd of 47 steers pastured on land of which the greater part was of a wet, boggy nature, covered with tufts of wild grass, although several acres in the 100-acre field were dry and produced tame grass. The cattle were watered from a 100-foot well bored through limestone rock. The

cattle were in this field from spring until early fall, during which time 5 of them died. In October the cattle were turned out into upland pastures where 4 others died. Subsequently 7 other animals perished after an illness of a few days.

The disease was manifested by a persistent chasing of whatever small animals would come near, accompanied by paroxysms of trembling and weakness. The animals at all times were in an uneasy state, sometimes amounting to frenzy, and in the late stages of the disease, after 3 or 4 days, paralytic symptoms set in so that the sick animals finally were unable to stand upon their feet. Few lesions were discovered by autopsies, engorgement of the blood vessels, especially in the brain, being the main pathological conditions noted. Rabies being suspected, although a history of but one mad dog or other animal in several years previous was ascertained, inoculations of brain tissue from animals which had died of the disease were made upon rabbits and calves. All the inoculated rabbits and the greater number of the calves died with unmistakable symptoms of paralytic rabies. Inoculations of other animals from the brains of inoculated animals which had died, produced the disease in every instance.

The source of the disease is considered as unsettled, although it is thought to be possible that the low, boggy pasture land had much if not all to do with its origin.

Colic in horses and mules, W. E. A. WYMAN (*South Carolina Sta. Bul. 22, n. ser., pp. 8*).—This is a popular bulletin discussing the causes, symptoms, prevention, and general treatment of colic, with additional detailed remarks in regard to spasmodic or cramp colic, flatulent colic, impaction colic, and habitual colic. Moderation in eating and drinking and the use of proper food is insisted upon, and in general for treatment are recommended, catheterizing the sick animal, intestinal injections, and the application of a drench of belladonna, hyoscyamus, cannabis indica, and nux vomica, with the addition of some other drugs in some cases.

Further experience with tuberculin, J. L. HILLS and F. A. RICH (*Vermont Sta. Rpt. 1894, pp. 71-74*).—Notes and tabulated data on tuberculin tests made with the new station herd. Forty-one cattle were tested in April and October, 1894, and in June, 1895, none of them giving reactions sufficient to indicate the presence of tuberculosis. Two remaining members of the old herd reacted at the October test and were slaughtered. The continued good health of the new herd is regarded as evidence that tuberculin, properly prepared and handled, can not cause tuberculosis.

A brief note is given on injections made throughout the State. There were inoculated 1,809 cattle in 84 herds, and 234 were found tuberculous. This percentage is not believed to indicate the extent of tuberculosis in the State, for the injections were usually made in herds where there was reason to suspect the existence of the disease.

Brief mention is made of the use of tuberculin in other States.

Mallein as a diagnostic for glanders in horses, F. A. RICH (*Vermont Sta. Rpt. 1894, p. 141*).—Notes and tabulated data on the temperature record and *post-mortem* notes for 11 cases in which mallein, procured from the Bureau of Animal Industry of this Department, was injected as a diagnostic for glanders. Six of the animals reacted and on being killed proved to be badly diseased.

Bovine tuberculosis, J. L. HILLS and F. A. RICH (*Vermont Sta. Rpt. 1894, pp. 17–70, pls. 2, figs. 2*).—A reprint of Bulletin 42 of the station (E. S. R., 6, p. 663).

DAIRY FARMING—DAIRYING.

Robertson mixture vs. corn silage, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 142–148*).—In one part of a silo was placed field corn alone, and in another the Robertson mixture of corn fodder, horse beans, and sunflowers. Owing to the dry weather the stand of horse beans was poor, and in order to get sufficient of the mixture for a feeding test soja beans were used. Analyses are given of the corn fodder, horse beans, soja beans, sunflower heads, and the 2 kinds of silage, and the loss of constituents in ensiling is calculated. The loss of dry matter in ensiling was 27.6 per cent for the corn silage and 33.7 per cent for the Robertson mixture. "The losses are excessive, greater than should occur in a good silo. As usual they fall mainly upon the more soluble carbohydrates."

The 2 kinds of silage were fed in an experiment with 6 cows, covering 4 periods of 4 weeks each. The cows were divided into 2 equal lots, fed alternately on the 2 kinds of silage. Each of the cows received 10 lbs. of hay per day, from 45 to 50 lbs. of silage, and while on corn silage 4 lbs. of bran and 4 lbs. of corn meal daily; while on the Robertson mixture 2 lbs. less of grain per day was fed for every 50 lbs. of silage. The individual records of the cows are tabulated and the data summarized.

The following table shows the average yields for the last 15 days of all the periods:

Yield and composition of milk from cows on corn silage and on Robertson mixture silage.

	Milk yield.	Composition.			Total yield of—		
		Total solids.	Fat.	Solids-not-fat.	Total solids.	Fat.	Solids-not-fat.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*
Corn silage	4,007	14.32	5.04	9.28	574	202	372
Robertson mixture silage	3,978	14.50	5.15	9.35	577	205	372

"Considering the yields from the dry matter eaten, the balance is strongly in favor of the Robertson mixture, more milk and butter being produced than from similar weights of dry matter in corn silage. The cows, if anything, gained in weight on the mixture. It seems that in this test, at any rate, the claims made for the mixture are not without basis.

"Notwithstanding the favorable results in this trial, the writer does not feel as yet like recommending the mixture to the Vermont dairyman. We have not thus far been able to grow horse beans successfully. We have grown them for 2 years, but neither time have had a satisfactory stand, although the soil conditions seemed favorable."

Robertson mixture and corn silage vs. roots, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 148–150*).—At the conclusion of the above experiment the cows were fed a mixture of silage made from corn and from Robertson mixture, with hay and grain, for 2 weeks. They were then gradually changed to a mixture of cut beets and carrots in an interval of 1 week, and fed 45 lbs. of this mixture per day for 2 weeks, with the same amounts of hay and grain as in the first period. Analyses of the 2 kinds of silage and of the corn and beets are given, and the data for the feeding trial, including the composition of the milk, are tabulated for each of the cows.

"On the whole, the results appear to be about even. We do not feel like laying stress upon them, however, because of the short duration of the trial. An extended test of corn silage and roots is planned for the coming winter."

Effect of fatigue upon the quantity and quality of milk, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 162, 163*).—In April 17 cows purchased by the station were driven 10 miles, shipped 50 miles by rail to Burlington, and then driven to the station, about a mile and a quarter, where they arrived about dusk, having been all day on the road. October 8 more were purchased, which traveled the same route under similar conditions. The yield and composition of the milk given by each of these cows on the night of arrival, the next morning, several days later, and 2 weeks later are tabulated. A summary of the averages for each lot is given in the following table:

Average yield and composition of milk of cows after a journey.

	Milk yield.	Total solids.	Fat.	Solids-not-fat.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*
First lot:				
Night of arrival	7.5	14.95	5.45	9.50
Morning after arrival	7.4	16.70	7.28	9.42
Two weeks after arrival	8.8	13.90	4.55	9.35
Second lot:				
Night of arrival	8.8	14.10	5.04	9.06
Morning after arrival	11.0	14.98	5.90	9.08
Two weeks after arrival	12.7	14.14	4.88	9.26

"The milk flow was lessened by fatigue, the general quality decidedly bettered, and the butter yields increased. Half of the cows gave richer and half essentially the same [amount] of poorer milk on the evening of the day of travel as they gave after recovery from fatigue. All gave richer milk the morning following the travel than 2 weeks later, and, with 3 exceptions, richer than the night before. The fat was the most variable constituent, the solids-not-fat remaining quite uniform."

On the influence of the fodder on the fat content of milk, H. STEFFEN (*Deut. landw. Presse, 23 (1896), Nos. 18, p. 152; 20, pp. 168, 169*).—The author does not agree with Sebelien's conclusion that there is very little evidence that the composition of milk is affected by feeding.

He cites a number of examples from practice, especially the records of milk delivered by creamery patrons, which he is quite sure show that the food is a very important factor in determining the quality of milk.

Tests of cream separators, H. H. WING (*New York Cornell Sta. Bul. 105, pp. 605–620*).—During the short dairy course of 1895 a series of tests of the efficiency of separators was made similar to the tests made the preceding year and reported in Bulletin 66 of the station (E. S. R., 6, p. 245). The machines were operated by students in the dairy course under the direction of an instructor, but none of the tests recorded were made until after the class had been at work for nearly a month and the students had had considerable practice in handling the various machines.

The fat in the skim milk was determined by the Babcock test. The results of the test, including the maximum, minumum, and average percentage of fat in the skim milk, are summarized in the table below:

Summary of tests of separators.

Separator.	Average temperature of milk.	Average revolutions of bowl per minute.	Average amount of milk separated per hour.	Fat in skim milk.		
				Minimum.	Maximum.	Average.
	Deg. F.		*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*
Butter accumulator *a*	86	7,438	414	0.01	0.20	0.10
De Laval Acme Alpha	85	6,185	1,088	.01	.10	.05
De Laval Baby No. 3	87	5,720	560	.01	.15	.06
Reid's Improved Danish	83	4,485	1,906	.01	.25	.11
United States No. 3	87	7,578	562	.01	.10	.05
Victoria, 75 gallon	86	6,686	790	.05	.20	.09

a Used as a separator.

Tests at factories.—With a view to studying the efficiency of different separators of the same make, visits were made to factories in the vicinity of Ithaca and samples taken of the skim milk and other data secured. In all, 22 factories and 3 private dairies were visited, and the working of 30 machines of 4 different makes and 9 different sizes and styles were studied. The separators studied were Alexandra Jumbo, De Laval Alpha No. 1, Baby No. 2, and Standard; Sharples Russian, Standard, and Imperial; and United States.

"In all the tests the machines were entirely in the hands of the factory operators and were run by them in their ordinary manner.

"Equal portions of the skim milk were taken from the skim-milk outlet at intervals of 10 or 15 minutes, according to the amount of milk separated, and from these mixed together a sample was drawn for analysis. The determinations of fat in the skim milk were made in skim-milk Babcock bottles in all tests that were made previous to September 14. In the tests made on and after that date the determinations were made with the new B. & W. double-necked bottle for testing skim milk and buttermilk. We have found this bottle much more convenient and more accurate for testing skim milk than the ordinary skim-milk Babcock bottles, because of the ease with which it is possible to measure slight differences in percentage of fat. We have found, too, in comparison with the skim-milk Babcock bottle, that the B. & W. bottle will give a slightly larger reading of fat. . . .

"In regard to the tests as a whole, the percentages of fat are considerably higher than those found in the machines used at the station, and it will be seen also that in most of the different kinds of machines there is quite a large variation between the highest and lowest percentage of fat, in every case amounting to 100 per cent and in most cases to considerably more.

"In the case of all of the various makes, except the Jumbo, at least one of the machines tested did what is called 'practically clean skimming;' that is, the percentage of fat in the skim milk was 0.1 per cent or less. In the case of the machines where a greater percentage was left in the skim milk, in many cases it was evidently due to carelessness of the operator, but in other cases it seemed to be some inherent quality of the machine. It would seem, therefore, that since it is possible that machines of the various makes that will do perfect work can be made that it is due the operator to demand from the manufacturer a guarantee of such perfect work."

Results of tests at various stations.—The data are summarized for the tests of separators which have been reported by the Vermont, Pennsylvania, Wisconsin, Iowa, and New York Cornell stations, and the following average is given of the percentage of fat found in the skim milk from the different separators and in different series of trials.

Fat in skim milk from different separators.

Kind of machine.	Average.		Minimum.	Maximum.
	By series.	Of all trials.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Accumulator	0.12	0.11	0.01	0.20
Alexandra Jumbo	.22	.22	.15	.33
Columbia	.09	.12	.05	.34
Danish Weston	.10	.08	.01	.25
De Laval	.13	.09	.01	.50
Sharples	.27	.16	.05	.65
United States	.18	.12	.01	.60
Victoria	.21	.16	.05	.38

"The results of all of these trials show that it is possible to separate the cream from milk with a loss of not more than 0.1 per cent of fat in the skim milk.

"That in all probability there is nearly as much difference in efficiency of separation between different machines of the same make as there is between the different makes themselves."

Tests of dairy apparatus, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 151-160*).—In connection with the dairy school tests were made of the relative efficiency, power consumption, and steam consumption of the De Laval Alpha Turbine, De Laval Acme, Jumbo, United States No. 3, United States No. 5, De Laval Alpha No. 2, and De Laval Alpha No. 3 separators. There were 4 hand and 5 power separators. The data for these trials are tabulated, together with the losses in churning. The average percentages of fat in the skim milk were as follows:

	Per cent.
De Laval Alpha Turbine	0.05
De Laval Acme	.10
Jumbo	.21
United States No. 1 B	.08
Reid Improved Danish	.07
United States No. 3	.07

"The comparative steam consumptions of the De Laval Alpha Turbine and the United States No. 1 B Belt Separator were carefully determined this year by Prof. A. W. Ayer, of the Mechanical Department of the University. . . . From the results it appears that under the conditions prevailing during the tests, the belt machine used only 86.3 per cent of the steam required by the turbine while separating the same amount of milk. . . . It is Professor Ayer's judgment that 'while the saving in steam by the belt machine might not be considered sufficient to warrant the extra expense of an engine if only one separator were to be used, I believe there should be no doubt as to the type of separator to be used if several of them were to be run in the same creamery, and that the belt machine in such cases should be chosen.'"

Comparison was made of the Moseley & Stoddard Co. and the Vermont Machine Co.'s steam Babcock testers, 28 and 30 tests being made, respectively. The average was 4.75 per cent of fat by the former and 4.78 per cent by the latter.

"The tendency throughout seemed to be toward slightly higher results in the Farm Machine Co.'s tester. . . . A long series of trials of the two against the Russian Babcock test averaged: Steam turbine machines, 5.18 per cent; Russian, 5.09 per cent. It is but fair to say, however, that recent comparisons of the steam Babcock with gravimetric tests (Adams's paper coil method) at this station seem to indicate that the former may run from 0 02 to 0.05 per cent too high."

The lactanalyt, a new milk tester, J. L. HILLS (*Vermont Sta. Rpt. 1894, pp. 161, 162*).—This tester, which has been sold to some extent in the State, is said to be a modified butyrometer. In making the test about 10 cc. of milk is mixed with an alkaline solution furnished with the tester, alcohol, and ether, the liquids being intimately mixed by means of a brush. The mixture is warmed slightly and then the ether-fat column read off on the neck of the tube by means of a metallic measure, which is supposed to show the percentage of fat directly.

A series of comparisons of the tester with the Babcock tester showed a difference between the 2 methods of from nothing up to over 2 per cent. As a rule the figures were too low.

Pasteurized vs. sterilized milk, A. R. LEEDS (*Dairy, 1896, No. 88, p. 95*).—A discussion of the relative merits of each. "Viewed from an everyday practical standpoint, the result of a general consideration and trial on the part of the medical fraternity and also of the general public has been a decision in favor of pasteurized *vs.* sterilized milk."

Experiments on removing the free acid from rancid butter by heating and by washing, K. FARNSTEINER (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), No. 3, pp. 84–89*).—From a number of experiments the author concludes that heating rancid butter to the temperature commonly obtained in cooking removes less than one-fifth of the free acid. It is possible to remove only a small part of the free acid by very thorough washing.

Tests for milk, E. RIGAUX (*Jour. Agr., 7 (1896), No. 75, pp. 125, 126, figs. 2*).—The acid test for fat of Dr. Gerber, of Zurich, is described and the apparatus figured. No heat is employed, and the sample has to be in the apparatus only 2 or 3 minutes.

AGRICULTURAL ENGINEERING.

Irrigation in Oklahoma, G. E. MORROW (*Oklahoma Sta. Bul. 18, pp. 17*).—Meteorological data are reported to show that the rainfall in the Territory is frequently not sufficient for the full development of crops, the amounts in general decreasing from the east to the west. In respect to distribution "Oklahoma is fairly but not entirely fortunate. . . . We have no distinct wet and dry seasons. Generally the principal rainfall occurs during the growing season. On the other hand, droughts during critical periods of crop growth are not uncommon. The total rainfall is sometimes largely made up of excessively violent rains and of very slight showers."

The conditions are also favorable to rapid evaporation. This, together with the fact that much of the soil of the Territory is fine and closely packed, suggests that subsoiling to increase storage capacity and frequent surface tillage to reduce evaporation would be very beneficial.

"If irrigation is to be practiced on the majority of the farms in Oklahoma, it must be by the use of water drawn from wells, or from ponds in which storm water has been stored. The rivers and streams of the Territory do not have wide valleys as a rule. It is not probable that much will be done, for some years at least, in the way of organizing companies for building canals and establishing large irrigation systems. As yet little is known as to the existence of 'underflow waters,' even in the river valleys. Nothing is known, with certainty, as to the possibility of securing large supplies of water from artesian wells in this region. The water of some of the rivers and smaller streams has so much saline matter that its use for irrigation would be objectionable.

"The most practicable power for lifting the water, in a vast majority of cases, is a wind wheel."

Methods to be followed and precautions to be observed in introducing the practice of irrigation into this region are given.

Influence of the distribution of the load and the inclination of the traces on the consumption of the strength of draft animals (*Deut. landw. Presse, 23 (1896), No. 24, p. 208, figs. 3*).—This is an abstract from an exhaustive treatise by H. Reinhardt on the subject, as applied to 4-wheeled farm wagons. The author concludes that for ease of draft on solid roads the load should be concentrated as much as possible on the rear axle; for soft roads, fields, and where the formation of ruts is possible, the load should be distributed equally over both axles. An upward inclination of the traces is always to be recommended, especially on bad roads and on soft fields. The degree of this inclination must be decided by the height of the fore wheels, the height of the draft animals, and the way in which they are hitched to the wagon.

As to the best place for the drawbolt, it must be at such a point on the pole as to avoid side draft. If other considerations do not interfere the whifletrees and drawbar should, in most cases, be placed under the

pole. The length of the traces depends on the most favorable angle of draft. On technical grounds long traces should be avoided unless there are good reasons for using them.

Supplemental irrigation at the Illinois Eastern Hospital for the Insane, C. GAPEN (*Reprint of address before the Illinois State Hort. Assoc., pp. 8; Irrigation Age, 9 (1896), No. 1, pp. 1–3, pls. 3*).—An account is given of irrigating 150 acres of land planted to fruits and vegetables. "The cost of laying the pipe was to the institution about $1,500, or about $10 per acre. The land before these pipes were laid would be regarded as high priced for agricultural purposes at $100 per acre; it now has a producing value to the institution of $500 per acre." The yield on the irrigated area was far greater than the average in the surrounding regions. The economy and methods of irrigation in humid regions are discussed.

Hillside terraces or ditches, F. E. EMERY (*North Carolina Sta. Bul. 121, pp. 319–326, pls. 2, figs. 4*).—Directions are given for the construction of hillside terraces according to the method originated by P. D. Mangum, of Wake Forest, North Carolina, in 1895.

The great flooding system of the San Joaquin Valley, T. S. VAN DYKE (*Irrigation Age, 10 (1896), No. 1, pp. 8–17*).

More practical irrigation in Kansas, I. N. PEPPER (*Irrigation Age, 10 (1896), No. 1, pp. 7, 8*).

Irrigation and subsoiling in Montana, S. M. EMERY (*Irrigation Age, 10 (1896), No. 1, pp. 17, 18*).

Fertilizing irrigation, J. SHOMAKER (*Amer. Agr. (mid. ed.), 1896, July 4, p. 30, fig. 1*).

Storage reservoirs, evaporation, and percolation, F. C. FINKLE (*Irrigation Age, 10 (1896), No. 1, pp. 19–21*).

The Nebraska irrigation annual for 1896 (*pp. 210, figs. 6*).—This is an account edited by A. G. Wolfenberger of the proceedings of the third annual convention of the Nebraska State Irrigation Association, held at Sidney, Nebraska, December 18 and 19, 1895, "with an appendix of valuable tables and special articles contributed by irrigation experts," including among other valuable matter a report by O. V. P. Stout on the flow of the different streams in the State available for irrigation and a synopsis of the irrigation laws of Nebraska.

New grain centrifuge with fans and grader (*Deut. landw. Presse, 23 (1896), Nos. 60, p. 534, figs. 2; 61, p. 543*).—The grain is first subjected to a blast of air, which removes all chaff, etc. It then passes over a sieve, which allows the grain to pass through and carries over larger particles like stones, peas, beans, etc. The grain then passes into a revolving cylindrical sieve, in which the small seeds of weeds, etc., are taken out. It then passes into a revolving vertical sieve with sides flaring upward and outward. In this the grain is divided into 3 portions according to size. In a trial at Leipsic the machine did superior work in every way.

The Ingleton steam plow (*Sci. Amer., 74 (1896), No. 19, p. 292, fig. 1*).—The plows work at right angles to the line of movement of the carriage to which they are attached, and a strip 30 to 50 ft. wide is plowed for each time across the piece. The cost of plowing an acre by this system is estimated at 45 cts.

A new electric plow, F. BRUTSCHKE (*Deut. landw. Presse, 23 (1896), No. 45, p. 399, fig. 1*).

The Brabant double plows at the local agricultural fair at Monlius, M. RINGELMANN (*Jour. Agr. Prat., 60 (1896), I, No. 25, pp. 895–902, figs. 5*).—In this article the author gives an illustrated description of this type of plow, with a mathematical discussion of the relations of the different parts.

Tests of agricultural machinery at Ultuna Agricultural Institute (Sweden), 1894, H. JUHLIN-DAMMFELT and W. MELIN (*Rpt. Ultuna Agl. Inst. 1894, pp. 99–112*).—Tests are reported of several forms of grain seeders, seed cleaners, and mowing machines.

Agricultural machinery in Denmark during 1895, H. F. K. DENCKER (*Tidsskr. Landökon., 15 (1896), pp. 156–167*).

Road construction, A. W. CAMPBELL (*Ontario Dept. Agr. Road Bul. 1, pp. 4*).—Brief directions are given for drainage of the roadbed, crowning the road, selection and placing of gravel, and repairs.

Roads and pavements in France, S. P. ROCKWELL (*New York: John Wiley & Sons, 1896, pp. 107, figs. 15*).—This book is partly the result of personal observation by the writer and partly a compilation from standard publications on roads by French engineers and from official documents.

It treats of the stone roads of France and includes, among others, the following topics: A perfect wagon road, grade, material for roads, gravel, broken stone, quality of various rocks used, preparation, cleanness, size of stone used, mode of construction, gravel road, stone road, roads with foundations, Trèsaguet's method, Telford's system, roads without foundation, Macadam's system, thickness on the Routes Nationales, binding material, convexity, maintenance and repair, general recharging, rolling, cost of construction in United States and in France, and cost of maintenance.

Enlarging and arranging a barn, I. P. ROBERTS (*Country Gent., 61 (1896), No. 2271, p. 612, figs. 5*).

Notes on the construction of dairies, F. W. WALLER (*Agl. Students' Gaz., 7 (1896), No. 6, pp. 209–219, pl. 1*).

STATISTICS.

Organization list of agricultural experiment stations and institutions with courses in agriculture in the United States (*U. S. Dept. Agr., Office of Experiment Stations Bul. 27, pp. 93*).—This contains the organization list of agricultural colleges and experiment stations revised to January, 1896; a subject list of publications of the experiment stations received by this office during 1895; Federal legislation relating to the colleges and stations; and the rulings of the Treasury and Post-Office Departments as to the construction of the act of Congress of March 2, 1887, establishing the stations.

Reports of the director and treasurer of Florida Station for 1894 (*Florida Sta. Rpt. 1894, pp. 4*).—A brief outline of the work of the year and a statement of receipts and disbursements for the year ending June 30, 1894.

Annual Report of the Louisiana Stations for 1895 (*Louisiana Stas. Rpt. 1895, pp. 8*).—Brief remarks on the work of the 3 stations in the State, list of bulletins published, and a financial statement for the fiscal year ending June 30, 1895.

Annual reports of director and treasurer of Vermont Station for 1894 (*Vermont Sta. Rpt. 1894, pp. 9–16*).—This includes a brief review of the work of the year by the director and a treasurer's report for the fiscal year ending June 30, 1894.

Abstract of bulletins of Vermont Station, 1894 (*Vermont Sta. Rpt. 1894, pp. 75–81*).—Abstracts of Bulletins 41, 43, and 44 of the station (E. S. R., 6, pp. 26, 994, 1007).

Annual Report of the experiment station of the Department de l'Aisne (*République Française, Dept. de l'Aisne, Sta. Agron., Bul. 1895, pp. 87*).—This bulletin contains meteorological data for 1895, a general meteorological résumé for the years 1890–'95, and reports on investigations of the following questions: The rôle of commercial fertilizers associated with barnyard manure; the best form of nitrogen, phosphoric acid, and potash for sugar beets; the effect of applications of pyritic ashes and of sulphate of iron; negative action of the products of coal oil distillation

against nematodes; sylphid beetle of the beet and practical means for destroying it; the composition of wheat; the mode of development of *Rhizoctonia violacea;* and varieties of cider apples.

Prices and number of farm animals in the United States (*U. S. Dept. Agr., Division of Statistics Rpt. 134, n. ser., pp. 8*).—This treats of prices and number of farm animals in the United States in January, 1896, and reports weather and crop conditions in Europe.

Monthly crop reports for March, April, and May, 1896 (*U. S. Dept. Agr., Division of Statistics Rpts. (n. ser.), 135, pp. 16; 136, pp. 7; 137, pp. 8*).—These consist of the usual monthly reports on the condition of the principal crops and reports of the European agents. No. 135 contains, in addition, statistics on the corn, wheat, and tobacco crops of 1895; No. 136 gives the condition of farm animals in the United States and losses from disease and other causes for the year, together with notes on the health of the people, and No. 137 gives notes on weather conditions and the legal weights per bushel of the principal farm products in the different States.

Crops and live stock in Ontario (*Ontario Bureau of Industries Bul. 57, pp. 14*).—Statistics on the condition of crops, live stock, etc., with extracts from returns of correspondence.

Agricultural returns for Great Britain for 1895, P. G. CRAIGIE (*London: Eyre & Spottiswoode, 1896, pp. 248*).—This report shows the acreage and produce of crops, prices of grain, and number of live stock, with agricultural statistics for the United Kingdom, British possessions, and foreign countries. For Great Britain the average yield per acre of wheat was 26.33 bu., of barley 32.09 bu., of oats 38.67 bu., of potatoes 6.6 tons.

NOTES.

ARIZONA STATION.—Mark Walker, assistant horticulturist, has severed his connection with the station, the position being discontinued.

DELAWARE STATION.—M. H. Beckwith has resigned his position as horticulturist and entomologist, the resignation taking effect September 1, and G. Harold Powell has been elected as his successor.

MASSACHUSETTS STATION.—To meet the increasing demands upon the station the legislature of Massachusetts has granted $7,000 for the purpose of enlarging the laboratories of the station for analysis of fertilizers and food and feeding materials.

PENNSYLVANIA STATION.—C. A. Browne, B. A., has been appointed assistant chemist of the station, *vice* M. S. McDowell, B. S., resigned, commencing his duties September 1.

WYOMING STATION.—W. H. Fairfield, B. S., assistant to the agriculturist and horticulturist, has also been made superintendent of the Laramie Farm.

VITICULTURAL COLLEGE AT RUTHERGLEN, AUSTRALIA.—The corner stone of a viticultural college was laid at Rutherglen, Australia, June 12. The wine-making industry is an important one in this region, and it is intended that the college shall carry on both experimental and educational work. A valuable work of the station will be the raising of rust-resistant vines. Special efforts will be made to disseminate the results of the work by personal visitation of fruit growers in different parts of the colony. Similar work with tobacco is in progress at the station under the supervision of Prof. A. J. Bondurant, formerly of the Alabama College Station.

HARVARD UNIVERSITY AND BUSSEY INSTITUTION.—The medical school of Harvard University having received a gift of $100,000 to endow a chair of comparative pathology the position has been filled by the appointment of Dr. Theobald Smith, formerly of the Bureau of Animal Industry of this Department and more recently professor of applied zoology at the Bussey Institution.

The announcement of the reopening of Professor Storer's chemical laboratory at the Bussey Institution will be received with great interest by all friends of agricultural science. The reports of the investigations in this laboratory more than a score of years ago were very valuable, and did much to awaken interest in agricultural science in this country and to aid the movement which culminated in the establishment of the experiment stations. Pecuniary disability, due to the great Boston fire of 1872, crippled this work for many years, but it is hoped that it will be possible to carry on important investigations in the future.

The Arnold Arboretum becomes richer in specimens and more valuable for purposes of information and instruction with every year.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1–11.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894; No. 20, Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Chicago, Illinois, October, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895; No. 24, Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., November 13–15, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Denver, Colorado, July 16–18, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University, Lafayette, Indiana, in 1895.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use.

Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII No. 2

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
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F. H. HALL—Statistics and Bibliography.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

VOL. VIII. NO. 2.

The Second International Congress of Applied Chemistry, held in Paris July 27–August 5, 1896, included much of interest to agricultural chemists. It was attended by Dr. H. W. Wiley as a delegate from this Department, who has furnished the material for the following statements.

The congress was organized under the patronage of the French Government and under the immediate direction of the *Association des Chimistes de Sucrerie et de Distillerie de France et des Colonies.* Through the French foreign office all the principal Governments were invited to send delegates, and official delegates were present from Austria, Belgium, Denmark, Germany, Italy, Portugal, Russia, Switzerland, and the United States. Between 500 and 600 persons attended the congress, but about 2,000 sent their membership subscriptions.

Although the congress represented the interests of the various branches of applied chemistry, such as the manufacture of sugar and fermented liquors, chemical products, dyestuffs, metallurgy, medical chemistry, toxicology, pharmacy, electrical chemistry, and photography, as well as agricultural industries, papers and discussions on subjects related to agriculture and agricultural chemistry were perhaps more numerous than in any other line. The participants included many agricultural chemists and investigators of world-wide reputation. There were, for instance, papers on the influence of culture on the chemical and physical properties of the soil, by P. P. Dehérain; the assimilability of phosphates, by L. Grandeau; the determination of soil elements assimilable by plants, the phosphate industry, and the plan and installation of an agricultural experiment station—the latter by Soillard. The subject of dairying was well represented by papers on the best methods of disinfecting stables and creameries by chemical means, the effect of food on the composition and character of milk and butter, and discussions of the best means of providing cities with pure milk and the use of pure cultures in butter and cheese making. On the latter point the work done in the United States did not seem to be fully realized.

There were many interesting papers on the methods of agricultural analysis. Several papers discussed the determination of phosphoric acid in soils and fertilizers, dealing especially with the methods applicable to phosphatic slags. The Wagner method of solution in ammonium citrate of definite composition was advocated by nearly all those taking part in the discussion. A paper by Dr. von Grueber gave the official German method of determining iron and alumina in phosphates. The method of E. Glaser, as modified by Jones, is regarded by German chemists as the most reliable for this purpose. Petermann discussed the detection and prevention of fraud in the sale of commercial fertilizers, and Kjeldahl gave a brief statement of the present methods of conducting his process for the determination of nitrogen in moist combustion. There were also communications and résumés on methods for the analysis of fats, distinguishing of butter from oleomargarin, and sugar analysis. A paper by the representative of this Department on the importance of international agreement in methods of agricultural analysis was followed by a general discussion and a vote that the congress collect and publish in German and French the official methods of France, Germany, and the United States. An editor was appointed to take charge of this matter. There has been much discussion on international coöperation and methods before the Association of Official Agricultural Chemists, and it is a matter for congratulation that this preliminary step in that direction has been taken.

Of quite general interest was a paper by Moissan on the electrical furnace. The construction and operation of the furnace were described and a large number of samples of typical compounds obtained at the intense heat of the furnace were exhibited and a description given of their physical and chemical properties. Another discussion of unusual interest was devoted to the official graduation of instruments of precision. It was the general consensus of opinion that a uniform 100 gm. weight of platinum should be adopted by all countries, and that all implements and utensils for weight and volume should be referred to this standard. The official meter was regarded by all to be the ultimate standard of instruments to measure length.

The chemistry of food and nutrition received a goodly share of attention. There were interesting communications on food adulteration, the gases contained in canned goods, by Doremus, of New York, and the difficult digestibility of sterilized milk; and one entire session was devoted to the chemical study of processes of bread making, and especially to the methods of analysis of moist and dry gluten. An interesting exhibition was given of the workings of the latest form of bomb calorimeter for determining the thermal equivalents of food. The employment of aluminum in the construction of cooking utensils and its influence on the wholesomeness of food prepared therein was the subject of a paper by Baroma. It was shown that with proper pre-

cautions aluminum could be safely used, but that it presented few, if any, advantages over copper or other metals in common use.

There were many papers on various chemical questions connected with the manufacture of sugar from cane and beets, several giving the latest European processes for the manufacture of starch, and a number on matters related to wine making. The question of fermentation and the germicidal methods of controlling it by means of fluorids was discussed by J. Effront; and a communication was presented by C. J. Murphy, of this country, describing a new process of fermenting maize and showing the way to a more extended use of this product in European distilleries. A subject of interest to the Southern wine-growing States and California was a paper on vinification in warm climates.

These papers are to be published in full by the congress at an early date, and doubtless many of them will then be noticed in considerable detail.

An enjoyable and very profitable feature of the congress was the excursions. About half the time was devoted to these, and they served to prevent the tediousness of continued sessions of papers and discussions. One afternoon was spent in a visit to the celebrated agricultural school and experiment station at Grignon. The school and the farm connected with it were inspected, and the experimental plats of the station were explained by Dehérain, and afterwards in his laboratory he gave a brief explanation of the charts presenting the results of the experiments for many years.

Another afternoon was employed in inspecting the irrigating works lately constructed at Gennevilliers to supplement those at Asnières in disposing of the sewage of Paris. For more than a quarter of a century the city of Paris has been using its sewage for irrigation. The fact that in the light of this long experiment it has recently more than doubled the area under irrigation shows that the process is considered a practical success. The sewage of Paris consists mostly of the water used for washing the streets. As water-closets are to a large extent connected with vaults, the sewage is not so highly polluted nor so rich in fertilizing materials as might be supposed. The fields irrigated contain 799 hectares (about 1,970 acres). The city of Paris expended 200,000,000 francs (about \$40,000,000) in acquiring the land and constructing the aqueduct, pumping machinery, and irrigating canals. The crops grown are vegetables and fruits—largely small fruits. The methods of irrigation are exactly those practiced in the arid regions of the United States. The gardens, though only 2 years old, presented a scene of almost tropical exuberance. Many dwarf fruit trees were already in bearing. Fortunately, the soil is of a sandy nature, permitting somewhat rapid filtration. At the end of the field next to the river the sewage which has passed through the soil reappears as a large stream of pure water, colorless and bright. The number of microörganisms, which is many millions in the sewage, is diminished to 2,500 per cubic centimeter of the seepage water.

One day was devoted exclusively to the exercises in honor of the late Louis Pasteur. In the morning the congress assembled in the chapel of Notre Dame and placed a memorial wreath on the coffin of the eminent savant. The final resting place of the body is to be in the court of the Pasteur Institute, where a tomb and monument are to be erected by popular subscription from all parts of the world. Later a most interesting visit was made to the Pasteur Institute, where the laboratories, clinical rooms, etc., were inspected, and to the stables of the institute at Garches, where are kept the 130 horses used to furnish the anti-diphtheritic serum.

Visits were also made to numerous laboratories, museums, botanical gardens, public buildings, manufactories, etc., in the vicinity of Paris, including the national porcelain works at Sèvres. One evening a lecture was given to the congress, in the amphitheater of the Sorbonne, on color photography, by Professor Lippman, who has achieved an international reputation by his researches in this important process. Another evening a banquet was given to the chairmen of committees of organization and to the delegates of foreign Governments, under the presidency of the minister of finances, which was attended by nearly 500 persons.

The final session of the congress was held in the grand amphitheater of the Sorbonne, under the presidency of the minister of commerce and industry. It was voted to hold the next congress at Vienna in 1898.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

On the estimation of organic matter by means of chromic acid, J. BARNES (*Jour. Soc. Chem. Ind., 15* (*1896*), *No. 2, pp. 82–84*).—The author's method is to add to 50 cc. of the solution to be tested 25 cc. strong sulphuric acid and 10 cc. of a solution of potassium bichromate containing 6.2 gm. of that salt and 50 cc. sulphuric acid to the liter. The mixture is heated 1 hour on the boiling-water bath, after which 10 cc. of a standard ferrous sulphate solution is added and titrated back with standard permanganate solution. A series of parallel experiments with this and the permanganate method is given, from the results of which the author concludes that the chromate method gives a better measure of the organic carbon than the permanganate method. The oxidation by permanganate was effected by $2\frac{1}{2}$ hours digestion at 70° in acid solution.—A. M. PETER.

On the preparation of water free from ammonia, J. BARNES (*Jour. Soc. Chem. Ind., 15* (*1896*), *No. 4, pp. 254*).—The author prepares ammonia-free water for nesslerizing without distillation by destroying the ammonia compounds by means of an alkaline hypobromite. A quantity of ordinary distilled water is put into a stoppered bottle and bromin vapor is poured in until the water is just perceptibly colored after shaking. A drop of strong soda solution is then added and the bottle again shaken. After standing about 10 minutes a few drops of potassium iodid are added to destroy the excess of hypobromite, and the water will then be found free from ammonia and suitable for use in nesslerizing.—A. M. PETER.

Note on a difficulty encountered in determining nitrogen by the absolute method, W. R. DUNSTAN and F. H. CARR (*Chem. News, 73* (*1896*), *p. 128*).—When nitrogen was determined in the base aconite by the absolute method, twice the amount of nitrogen corresponding to the accepted formula was found, but the absolute method gave good results on the hydrochlorid, as did also the soda-lime method on the base. An analysis of the gas from the combustion of the base by the absolute method showed it to be contaminated with methane.—B. W. KILGORE.

Combination of atmospheric and chemical nitrogen with metals, P. L. ASTANGLON (*Chem. News, 73* (*1896*), *p. 115*).—The author found

the nitrid of magnesium (Mg_3N_2) formed by burning magnesium in air by two methods to contain 26.42 and 26.82 per cent of nitrogen, as compared with the theoretical 28 per cent; while the nitrid formed by combination with chemical nitrogen contained 27.21 per cent of nitrogen.

He discusses the results of Ramsay and Rossel for magnesium nitrid.—B. W. KILGORE.

Determination of the citrate-soluble phosphoric acid in Thomas slag by direct precipitation of the citrate solution obtained in the Wagner method, W. HOFFMEISTER (*Chem. Ztg., 20 (1896), No. 31, p. 305*).—To an aliquot part of the citrate solution of 5 gm. of Thomas slag a small amount of concentrated sulphuric acid is added (5 cc. of acid for each gram of slag) and the solution evaporated until it is of a thick sirupy consistency and a slightly yellow color. The residue is washed into a measuring flask with hot water and after cooling the flask is filled to the mark with water. The solution is then filtered and an aliquot part of the filtrate corresponding to 0.5 gm. of slag is transferred to a beaker covered with a funnel, 10 cc. of fuming nitric acid added, and the solution heated over a small flame nearly to boiling. After rinsing off the funnel 50 cc. of the ammonium citrate solution ordinarily used in the determination of phosphoric acid is added, the solution cooled, and the phosphoric acid precipitated by means of 10 cc. of magnesia mixture in the presence of sufficient ammonia to neutralize the sulphuric acid and nitric acid present. For complete precipitation it is necessary to allow the solution to stand 12 hours with occasional stirring.

Rapid estimation of insoluble phosphate, V. EDWARDS (*Chem. News, 73 (1896), p. 25; abs. in Jour. Chem. Soc., 1896, Apr., p. 273*).—The method proposed is as follows: "The residue, from the exhaustion of 0.5 gm. of the substance with cold and hot water, is boiled for a short time in water containing a very small quantity of hydrochloric acid, filtered, made up to 300 cc., rendered alkaline with ammonia, and then faintly acidified with acetic acid. The solution is then placed on a sand bath and titrated hot with standard uranium acetate of the strength 1 cc. = 0.01 gm. $Ca_3P_2O_8$."

Investigations on the determination of phosphoric acid, C. MEINEKE (*Chem. Ztg., 20 (1896), No. 13, pp. 107-113*).—Tests of 2 methods are reported: Determination of phosphoric acid (1) by igniting the yellow molybdic precipitate, proposed by the author in 1885;[1] and (2) as magnesium pyrophosphate. In addition studies of the influence of ammonium chlorid on the molybdic precipitation of phosphoric acid in solutions rich in iron are reported.

The molybdic solution used in the first method is prepared as follows: Dissolve 150 gm. of ammonium molybdate in 150 cc. of ammonia of 0.91 specific gravity and 850 cc. of water and stir in 1,000 cc. of nitric acid of 1.2 specific gravity; heat for 10 minutes at 90° C., decant, and filter. The method is carried out as follows: In case of solutions

[1] Report Anal. Chem., 5 (1885), p. 153.

poor in iron, only 5 per cent of ammonium nitrate and a slight excess of free nitric acid should be present. Cool the solution to about 50° and add the required amount of molybdic solution, whereupon the temperature sinks to 35 to 40°. Let the solution stand until it is perfectly clear. With solutions rich in iron a high temperature is required, and the solution should contain at least 10 per cent of ammonium nitrate and from 5 to 10 cc. of free nitric acid of 1.4 specific gravity for every 100 cc. of solution. Heat the solution nearly to the boiling temperature, add the necessary amount of molybdic solution, and stir vigorously. Allow the precipitate to settle, and filter. For washing the precipitate use a solution containing 100 parts each of ammonia (0.91 specific gravity) and nitric acid (1.4 specific gravity), diluting to 1 liter. Wash until all iron is removed, finally using a little cold water and a small amount of 96 per cent alcohol or ether-alcohol, if the precipitate is large, dry it, and ignite in a flat platinum dish with a platinum cover at a very low red heat, scarcely perceptible in daylight. The ignited residue should be grayish when cooled and should contain no yellow or green particles. It should also be free from sublimed molybdic acid. Cool in a desiccator and weigh.

In the method originally proposed by the author this residue was given the formula $P_2O_5 \cdot Mo_{24}O_{68}$, which contains 4.018 per cent of phosphoric acid. A comparison on phosphorite of this method with that in which phosphoric acid was determined by weighing the magnesium pyrophosphate indicated that this factor was too high. Careful analyses of the ignited residue from precipitates obtained with disodium phosphate and trisilver phosphate according to the above directions showed that it had the formula $24MoO_3+P_2O_5$, with a phosphoric acid content of 3.944 per cent. By using this factor it was found that the results by the author's method, and by that in which phosphoric acid was determined by weighing the magnesium pyrophosphates, agreed very closely.

Two methods of determining phosphoric acid based upon the weight of magnesium pyrophosphates were tested, viz, that of Märcker[1] and that of Wagner.[2] In the first method the molybdate precipitate is dissolved in an excess of ammonia which is neutralized by hydrochloric acid before precipitation with a magnesia solution, a sufficient amount of ammonia being added to bring the final amount of ammonia in the solution up to 2½ to 3 per cent.

In the second method phosphoric acid is directly precipitated out of 2½ to 3 per cent of ammonia solution by means of magnesia mixture. These methods were tested on solutions of disodium and trisilver phosphates containing varying amounts of phosphoric acid. The results indicate that for the analysis of ordinary phosphates the Wagner method is sufficiently accurate. For very small amounts of phosphoric aicd a small plus error was found. The irregularities observed are

[1] Ztschr. analyt. Chem., 12 (1873), p. 447.
[2] Ztschr. analyt. Chem., 19 (1880), p. 44.

ascribed to variations in the length and intensity of ignition of the precipitate. Intense ignition appeared to increase the loss of phosphoric acid by decomposition of the metaphosphates, and this loss increased with the increase in weight of the precipitate. In the author's experiments it bore no definite relation to the correction given in Neubauer's table. The indications are that the precipitate of $Mg(NH_4)_4(PO_4)_2$ is very variable, and consequently that the proportion of metaphosphate in the ignited residue is also variable. Experiments are reported which indicate that the difference in weight between the gently ignited and strongly ignited precipitate gives a factor which may be utilized in calculating the relative proportion of metaphosphate and pyrophosphate present, and thus furnishes a more exact means of determining the percentage of phosphoric acid present. As a rule this method gave more reliable results than either Wagner's method or Neubauer's method with correction.

The results by the Märcker method were very variable, sometimes showing a plus error and sometimes a minus error. In many cases it was found that the precipitate contained a considerable amount of molybdic acid. The error due to formation of metaphosphate and volatilization of phosphoric acid was much smaller than in case of the Wagner method. This is explained by the fact of the simultaneous formation of $Mg(NH_4)_4(PO_4)_2$ and $Mg_3(PO_4)_2$, which yield on ignition magnesium pyrophosphate without loss of phosphoric acid when combined in proper proportion. If the amount of phosphoric acid present is not very large it is completely precipitated in the above forms in proportions which yield on ignition pure pyrophosphate, and the results generally show a plus error (due to other impurities). If phosphoric acid is present in large amounts the addition of the large amount of magnesia mixture, which is then necessary, favors the formation of an excess of $Mg(NH_4)_4(PO_4)_2$ and results in a minus error. The experiments reported indicate that although many of the precipitates contain molybdic acid, accurate results may be obtained by this method when precautions are taken to delay precipitation, as for instance, by the addition of citric acid.[1]

In order to get the best results, as Märcker has shown, the solution to be precipitated should not contain more than 2 gm. of phosphoric acid, and sufficient hydrochloric acid should be used so that precipitation does not commence until about one-half of the required magnesia mixture has been added. The precipitate should be strongly ignited in order to remove the molybdic acid which may be present.

The results of a number of experiments are reported, which indicate that the large amounts of ammonium chlorid resulting from the use of hydrochloric acid in the solution of phosphates rich in iron in no way affects the determination of phosphoric acid by the molybdic method.

Methods of phosphate analysis, O. GROTHE (*Amer. Fert.*, 4

[1] Ztschr. analyt. Chem., 32 (1893), p. 64.

(1896), No. 4, p. 204).—The following modification of Märcker's method has been found by the author to give good results in the analysis of phosphates:

"The ammoniacal solution of the ammonium phospho-molybdate obtained in the ordinary way from $\frac{1}{4}$ gm. of phosphorite is freed from the surplus of ammonia by either boiling or heating on the water bath, and to the neutral solution, after cooling, 2 drops of magnesia mixture is added, which should, after some stirring, produce a precipitate. Should this, however, be delayed, 1 or 2 drops of concentrated ammonia is added, always stirring until the precipitate shows itself. Then the precipitation is continued to the end in the ordinary way by the addition of the necessary magnesia mixture. After, say half an hour, ammonia is added as usual in the execution of the Märcker method. The precipitate of ammonium-magnesium phosphate, after washing with dilute ammonia, may for convenience sake be moistened by a concentrated ammoniacal solution of ammonium nitrate, as recommended by Glaser in the execution of the citric method. The ignition is done over the Bunsen burner until the filter is burned and finally to constancy of weight over the gas burner."

It is claimed that control analyses with $\frac{1}{4}$ gm. of pure silver phosphate "have demonstrated the absolute correctness of this modification of the Märcker method."

The molecular weight and formula of phosphoric anhydrid and of metaphosphoric acid, W. A. TILDEN and R. E. BARNETT (*Jour. Chem. Soc., 1896, Mar., pp. 154–160, fig. 1*).—A number of determinations by the Victor Meyer vapor expulsion process of the vapor density of carefully prepared samples of phosphoric anhydrid are reported which indicate a molecular weight corresponding to P_4O_{10}. In the preparation of the phosphoric anhydrid it was observed that the metaphosphoric acid formed was quite readily volatile. The results of 3 series of experiments on the vapor density of this compound indicate "that although the composition of metaphosphoric acid varies a little, the vapor of this substance consists chiefly of dimetaphosphoric acid $H_2P_2O_6$, which is apparently liable to undergo partial dissociation at a high temperature and even during ebullition to part with a small quantity of water.

The determination of potash, F. T. B. DU PRÈ (*Chem. Ztg., 20 (1896), No. 31, p. 305*).—In view of a suggestion to change the factor for calculating potash in potassium platinic chlorid, the author reports work by himself and others, which shows that the results of the determination of potash by any method are usually variable, and that accurate results can only be obtained by determining the factor which is applicable to the particular set of conditions under which the analyst works.

Determination of potash, A. PRAGER (*Chem. Ztg., 20 (1896), No. 27, p. 269*).—The method proposed for the determination of potash in combination with sulphuric acid is as follows: An aliquot part of the potash solution is precipitated with chlorid of barium in the usual manner, using the minimum excess of the chlorid. The filtrate from the sulphate of barium is diluted to 75 cc., platinum chlorid added, and the solution evaporated on a water bath kept below the boiling point.

This and subsequent operations must be carried out in an atmosphere absolutely free from ammonia. As soon as the formation of crystals on the surface of the solution is observed it is allowed to cool, and then again slowly evaporated to 5 cc. After cooling, 20 cc. of 90 per cent alcohol is added and the solution is allowed to stand for a long time with stirring. The crystalline precipitate is brought on to a filter which has been previously washed with 80 per cent alcohol and hot water, washed with 80 per cent alcohol, dried in a Hoffmeister drying oven at 110°, and weighed.

Tests of this method on pure sulphate of potash and mixtures of sulphate of potash with other salts gave results which agreed closely with the theoretical percentage of potash.

A method for determining the purity of butter by means of its density, R. BRULLÉ (*Compt. Rend., 122 (1896), No. 6, p. 325; Rev. Scient., ser. 4, 5 (1896), No. 8, p. 247; Jour. Agr., 1896, Mar. 7; abs. in Milch Ztg., 25 (1896), No. 19, p. 297*).—According to the abstract experiments showed that when the water, casein, and coloring matter were removed, the exact determination of the specific gravity of the fat remaining gave very reliable indication of the relation between the pure butter and the foreign fats added.

Estimation of uric acid by Fehling's solution, E. RIEGLER (*Ztschr. analyt. Chem., 35 (1896), No. 1, p. 31*).—The method depends on the formation of cuprous oxid when an alkaline solution of uric acid is boiled with Fehling's solution, an average of 0.8 gm. copper corresponding to 1 gm. uric acid, the extremes in 10 experiments being 0.7812 and 0.8333 gm. The method is described in detail.—B. W. KILGORE.

Further notes upon the fats contained in the tuberculosis bacilli, E. A. DE SCHWEINITZ and M. DORSET (*Centbl. Bakt. und Par. Med., 19 (1896), No. 18–19, pp. 707, 708*).—This reports a continuation of analyses of the tuberculosis bacilli, published by the same authors in 1895.[1] A mass of dried tuberculosis bacilli weighing about 3.5 gm. was collected and submitted to examination. The crude fat, constituting 37 per cent of the whole, was saponified in a closed flask by means of sodium hydrate, and the acids freed with sulphuric acid. The volatile fatty acids were removed by distillation, the 3.5 gm. of crude fat giving only 0.05 gm. of volatile fatty acids. They had an odor resembling that of sweet almonds. The non-volatile fatty acids were partly soluble in 85 per cent alcohol and the remainder in absolute alcohol. By means of fractional crystallization an acid melting at 62° C. was obtained and identified as palmitic acid. The acid soluble in hot 85 per cent alcohol was purified by repeated crystallization and showed a melting point of 102° C., which would indicate a higher carbon content than any acid heretofore noted in plants. The acid soluble in cold 85 per cent alcohol melted at 42 to 43° C. and is believed to be lauric acid. The work is being continued.—M. DORSET.

[1] Jour. Am. Chem. Soc., 1895, Aug.

Theories and applications of chemistry, BERTHELOT (*Rev. Scient., ser. 4, 6 (1896), No. 5, pp. 129–133*).

Combination of argon with water, P. VILLARD (*Compt. Rend., 123 (1896), No. 7, pp. 377–379*).

Deposition of aluminum from aqueous solutions, H. N. WARREN (*Chem. News, 73 (1896), p. 122*).

Note on the proportion of pure hydrofluoric acid, A. H. ALLEN (*Analyst, 21 (1896), p. 87*).

The nature of an oxidizing substance produced by distilling aqueous solutions of potassium permanganate and sulphuric acid in vacuo, C. C. FRYE (*Chem. News, 73 (1896), p. 122*).—The author concludes that the oxidizing agent produced is ozone.—B. W. KILGORE.

Study of commercial saccharin by means of the calorimetric bomb, H. LANGBEIN (*Ztschr. angew. Chem., 1896, No. 16, pp. 486–494, figs. 4*).

The chemical composition of the oil of sassafras bark and leaves, F. B. POWER and C. KLEBER (*Pharm. Rev., 14 (1896), p. 101; abs. in Chem. Ztg., 20 (1896), No. 50, p. 173*).

Rapid determination of carbonic acid in the air and in confined mediums, HENRIET (*Compt. Rend., 123 (1896), No. 2, pp. 125–127*).—The carbonic acid is absorbed by potash which is titrated with sulphuric acid, using phenolpthalein as an indicator. The red color disappears when one-half of the CO_2 present has united with the undecomposed carbonate present to form bicarbonate.

Official methods for the analysis of fertilizers issued by the German Manure Manufacturers' Association, Harzburg, May 28, 1895, H. H. B. SHEPHERD (*Analyst, 21 (1896), April, pp. 99–101; May, pp. 128–132; June, pp. 151–156; and July, pp. 186–191*).

On the method for the quantitative determination of copper in plants, V. VEDRÖDI (*Chem. Ztg., 20 (1896), No. 59, pp. 584, 585*).

Table for obtaining weight of phosphoric acid from magnesium pyrophosphate, P. GOETSCHKE (*Ztschr. analyt. Chem., 35 (1896), No. 2*).

Optical determination of sulphuric acid, AGLOT (*Bul. Soc. Chim. Paris, 15–16 (1896), No. 12, pp. 855–862*).

The quantitative estimation of tin, C. J. BROOKS (*Chem. News, 73 (1896), p. 218*).

A chemical study of the glycogen in fungi and yeasts, G. CLAUTRIAU (*Mém. Roy. Acad. Belgique, 1895, pp. 99; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 13, pp. 429–434*).

On the micro-chemical determination of nitrates in plants, W. ELLRAM (*Sittungsber. naturf. Ges. Univ. Dorpat, 9 (1895), No. 1, pp. 105–116; abs. in Bot. Centbl., 67 (1896), No. 3, p. 74*).

The determination of organic matter in water by means of permanganate of potash, SCOUPEVSKY (*Abs. in Bul. Soc. Chim. Paris, 15–16 (1896), No. 13, pp. 1210, 1211*).

The determination of dry matter in water and the examination of drinking water on a large scale, O. EBERHARD (*Chem. Ztg., 20 (1896), No. 49, p. 480*).

Polarimetric determination of lactose in human milk, P. THIBAULT (*Jour. Pharm. Chim., ser. 6, 16 (1896), p. 5; abs. in Chem. Ztg., 20 (1896), No. 60, Repert., p. 192*).

Note on the titration of quinin, A. H. ALLEN (*Analyst, 21 (1896), p. 84*).—The method is based on the neutrality of the sparingly soluble quinin sulphate (two molecules of the base to one of sulphuric acid) to cochineal, Brazil wood, and logwood, and the neutrality of the readily soluble acid sulphate (one molecule of the base to one of sulphuric acid) to methyl-orange.—B. W. KILGORE.

Review of progress in work on wines and food materials, E. LIST (*Chem. Ztg., 20 (1896), No. 46, pp. 448–455*).—A review of recent work on wines, fruit juices, flour and bread, water, meat and meat products, coffee, tea, and cocoa.

Chemical work in Canadian agriculture, F. T. SHUTT (*Reprinted from Ottawa Naturalist, 10 (1896), No. 2, pp. 29–43*).—This is a résumé of the work of the chemical

division of the Experimental Farms of Canada during the past 8 years. The topics treated are virgin soils of Canada, naturally-occurring fertilizers, fodders and farm crops generally, the grasses of Canada, Indian corn, fruits and vegetables, and well waters.

Report of the official analyst of the Island of Jersey (*Rap. Ann. Anal. Offic., pp. 12*).—This is for the year ending March 25, 1895, and includes brief reports on examination of alcoholic liquors, butter, baking powder, and waters, and on the inspection of waterworks. A table is given showing the fertilizing constituents removed from the soil of the island in the exports of potatoes and milk, and restored by the use of farm manure and artificial fertilizers.

A new form of carbonic acid apparatus, C. H. CRIBB (*Analyst, 21 (1896), p. 62*).

A modified filter pump, G. BERLEMONT (*Bul. Soc. Chim. Paris, 15–16 (1896), No. 15, p. 917, fig. 1*).

An auto-pneumatic stirrer, H. BEORLEY (*Chem. News, 74 (1896), No. 1915, p. 62*).

A registering thermometer for casks and vats, HOUDAILLE and ROOS (*Prog. Agr. et Vit., 26 (1896), No. 30, pp. 99–102, fig. 1*).

BOTANY.

The formation and use of the pentoses in plants and animals, GOITZE and PFEIFFER (*Landw. Vers. Stat., 47 (1896), p. 59; abs. in Chem. Centbl., 1896, I, p. 967*).—The pentoses are found in plants from the time of their earliest growth, and their formation proceeds proportionately with that of the cellulose. They can be used by the plant as a reserve material similarly to the true carbohydrates when the possibility of ordinary assimilation is removed by the exclusion of the light. The cereals or Gramineæ are especially rich in pentoses, while the Leguminosæ contain smaller quantities.

The animal organism partially absorbs and partially expels the pentoses. They seem to be intimately connected with the formation of hippuric acid, as the consumption of large quantities of easily digestible pentose is always followed by the appearance of hippuric acid.—W. H. KRUG.

On the relation between calcium and the transportation of carbohydrates in plants, P. GROOM (*Ann. Bot., 10 (1896), No. 37, pp. 91–96*).—A brief review is given of the investigations of Boehm, Schimper, and others upon the rôle of calcium in plants, and experiments of the author are described in which it is shown that the evil effect of a lack of calcium in a plant is due to the accumulation of potassic oxalate. Schimper has shown that oxalic acid is a by-product of the synthesis of proteids, and where there is no calcium present it unites with potassium, forming a soluble oxalate, which acts as a poison to plants.

The author summarizes his results, showing that acid potassium oxalate retards the action of diastase on starch. The presence of this substance is first shown by an accumulation of starch, owing to the arrest of its change into sugar. A second effect, as the oxalate accumulates, is the retarding of starch formation and probably the assimilation of carbon. The death of the protoplasm is the ultimate result of

the accumulation of the soluble oxalate. Since part of the carbon assimilated by the plant never enters into the starch condition the reason is evident why the growth of shoots or seedlings is not at once checked when deprived of calcium.

Copper as a constituent of vegetables, V. VEDRÖDI (*Chem. Ztg., 20 (1896), No. 40, pp. 399, 400*).—The author refers to his previous experiments[1], and compares the method of analyses with those of Lehmann[2] for the same purpose. He thinks the latter's method inferior to his own and especially liable to error. Numerous analyses were repeated and the results are tabulated. Analyses were made of various crops in 1894 and 1895, and the results in percentage of copper oxid are tabulated. The amount of metallic copper in the same seed was calculated in milligrams per kilogram of seed and the following result obtained:

Amount of metallic copper in 1 kg. of seed.

	1894.		1895.	
	Minimum.	Maximum.	Minimum.	Maximum.
	Mg.	*Mg.*	*Mg.*	*Mg.*
Winter wheat	80	710	200	680
Spring wheat	190	630	190	230
Corn	60	90	10	30
Barley	80	120	10	70
Oats	40	190	40	200
Buckwheat	160	640	150	160
Beans	160	320	110	150
Flax	120	150	110	150
Peas	60	100	60	110
Soja beans	70	100	70	80
Lupines	80	190	70	290
Hemp	70	130	60	70
Pepper pods	790	1,350	230	400

The form in which the copper gets into the plant and its poisonous properties are not known, but the author is disposed to think that the small quantity present will have no injurious effect upon the human or animal system.

Preliminary revision of the North American species of Echinocactus, Cereus, and Opuntia, J. M. COULTER (*U. S. Dept. Agr., Division of Botany, Contributions from the U. S. National Herbarium, vol. 3, No. 7, pp. IV, 355–462*).—The author has here completed the preliminary revision of the North American species of Cactaceæ, the first part having appeared in 1894 as Contributions from the United States National Herbarium, vol. 3, No. 2 (E. S. R., 6, p. 190). In the present report there are described 52 species of Echinocactus, 82 of Cereus, and 101 of Opuntia. Of this number many are described as new by the author and many others are published for the first time from the manuscript of Dr. Engelmann. Notes are also given as to the geographical distribution of the species.

On the genus Calamagrostis, E. TORGEO (*Mitt. Thuring. bot. Ver., 8 (1895), pp. 13–15; abs. in Bot. Centbl., 67 (1896), No. 3, p. 83*).—The author describes several new varieties and hybrids of this genus of grasses.

[1] Chem. Ztg., 17 (1893), p. 1932.
[2] Arch. Hyg., 24, p. 3.

Peculiar white flowered varieties of some species of plants, J. KLINGES *Deut. bot. Monatsschr., 14 (1896), No. 6–7, pp. 75–80).*

A remarkable variety of Populus tremula, P. ASCHERSON (*Deut. bot. Monatsschr., 14 (1896), No. 6–7, pp. 73–75*).

Three new species of Bursera, J. RAMIREZ (*An. Inst. Med. Nacional, 2 (1896), No. 1, pp. 14–18, pls. 3*).—*Bursera aptera, B. trijuga,* and *B. morelense* are described and figured from Mexico.

A new species of Casimiroa, J. RAMIREZ (*An. Inst. Med. Nacional, 2 (1896), No. 1, pp. 18–20, pl. 1*).—*Casimiroa pubescens* is figured and described as new.

Contributions to the knowledge of Puccinia sylvatica and P. sessilis, G. WAGNER (*Ber. deut. bot. Ges., 14 (1896), No. 6, pp. 212–215*).

Contributions to the biology of the Myxomycetes, C. LIPPERT (*Verhandl. zool.-bot. Ges. Wien, 1896, No. 6, pp. 235–242, pl. 1*).

On the transformations of Melampsora tremulæ, G. WAGNER (*Oesterr. bot. Ztschr., 46 (1896), pp. 273, 274*).

The order of development of the parasitic Exoasceæ, K. GIESENHAGEN (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 12, pp. 394, 395*).

On the formation of calcium oxalate in plants, J. WITTLIN (*Bot. Centbl., 67 (1896), Nos. 2, pp. 33–41; 3, pp. 65–73; 4, pp. 97–102; 5, pp. 129–133, pl. 1*).

The dependence of plant respiration on the amount of their unassimilable proteids, W. PALLADIN (*Charkow, 1895; abs. in Bot. Centbl., 67 (1896), No. 3, pp. 79–82*).

Biology of pollen, B. LIDFORSS (*Jahrb. wiss. Bot., 19 (1896), pp. 1–38; abs. in Jour. Roy. Micros. Soc., 1896, No. 4, p. 437*).—Attention is called to the difference in degree to which nearly related pollens resist the injurious action of water. In most anemophilous plants the pollen resists the action of moisture to a considerable extent.

Bark within a tree trunk, F. D. KELSEY (*Bot. Gaz., 22 (1896), No. 1, p. 54, fig. 1*).—Notes are given on the occurrence of a well defined bark on the inside of an elm tree trunk.

The physiology of color in plants, D. T. MACDOUGAL (*Science, n. ser., 4 (1896), No. 89, pp. 350, 351*).

Concerning the spontaneous emptying of reserve cells, K. PURIEWITSCH (*Ber. deut. bot. Ges., 14 (1896), No. 6, pp. 207–212*).

Some causes of fluctuation in the turgescence in the motor organs of leaves, D. D. CUNNINGHAM (*Ann. Roy. Bot. Gard. Calcutta, 6 (1895), I, pp. 161, pls. 5; abs. in Bot. Centbl., 67 (1896), No. 5, pp. 141, 142*).

Concerning the presence and physiological action of lecithins in plants, J. STOKLASA (*Bot. Centbl., 67 (1896), No. 6, pp. 161, 162*).

On the influence of earthworms upon the development of plants, M. DJEMIL (*Inaug. Diss. Halle, 1896; abs. in Bot. Centbl., 67 (1896), No. 8, pp. 235, 236*).

Individual variation in flowers and its significance, G. R. B. VON MANNAGETTA (*Wien. illus. Gart. Ztg., 21 (1896), No. 7, pp. 229–235*).

Fertilizers and flowers (*Garden and Forest, 9 (1896), No. 446, pp. 361, 362*).—Editorial notes are given on a recent address of Prof. R. C. Kedzie before the American Florists' Association on the application of fertilizers for flower growth.

Adaptation of plants to environment, H. DE VARIGNY (*Rev. Scient., ser. 4, 6 (1896), No. 5, pp. 140–145*).

Flowers and insects, C. ROBERTSON (*Trans. St. Louis Acad. Sci., 7 (1896), No. 6, pp. 151–179*).—Notes are given upon the adaptation for fertilization and insect visitors of *Hepatica acutiloba, Asimina triloba, Podophyllum peltatum, Solea concolor, Euonymus atropurpureus, Æsculus hippocastanum, Astragalus canadensis, A. mexicanus, Stylosanthes elatior, Gymnocladus canadensis, Spiræa aruncus, Gillenia stipulacea, Viburnum opulus, V. pubescens, Symphoricarpus vulgaris, Aster ericoides villosus, Silphium perfoliatum, Heliopsis lævis, Rudbeckia laciniata,* and *Cacalia reniformis.*

In regard to the application of "Nitragin" (*Deut. landw. Presse, 23 (1896), No. 69, pp. 615, 616*).—A popular article on the use of the Nobbe and Hiltner's "Nitragin."

The "nutrition" of the Leguminosæ, L. GRANDEAU (*Jour. Agr. Prat., 60 (1896), II, No. 36, pp. 329–332*).

The flora of Alabama, P. H. MELL (*Alabama College Sta. Bul. 70, pp. 276–296*).—This bulletin, which is one of a series to be devoted to the same subject, gives a list of species of Leguminosæ and Rosaceæ with their range throughout the State so far as known. The series is to be continued as material accumulates without reference to botanical sequence of families.

Contribution to the Myxogasters of Maine, F. L. HARVEY (*Torrey Bul., 23 (1896), No. 8, pp. 307–314*).

Notes on Indian fungi (*Agl. Ledger, 1895, No. 20, pp. 132, pls. 2, figs. 11*).

Capsicum, potatoes, and some other economic Solanaceæ of India, Y. GHOSA (*Indian Agr., 21 (1896), No. 7, pp. 209–212*).

A horizontal microscope, C. R. BARNES (*Bot. Gaz., 22 (1896), No. 1, pp. 55, 56, pl. 1*).—A description is given of a horizontal microscope devised by the author for the measurement of the vertical growth of plants.

METEOROLOGY.

Injury from frost and methods of protection, W. H. HAMMON (*U. S. Dept. Agr., Weather Bureau, pp. 12*).—The conditions favoring the formation of frost are popularly explained and the best locations for orchards or gardens to avoid injury by frost and methods of frost prevention are described, especially with a view to the needs of the agriculturists of California. The use of the psychrometer in determining the dew-point is explained, with tables giving the dew-point corresponding to different readings and temperatures likely to prove injurious to 43 farm crops at 4 different stages of growth.

"The experience of the past two seasons has shown that forecasts of sudden and decided changes in temperature over a large territory are among the most accurate made by the Weather Bureau; consequently it is reasonable to expect that if suitable arrangements are made warnings may be received of those otherwise unexpected cool waves which will result in frost. There are instances, however, when the general forecasts of the Weather Bureau can not be expected to be sufficiently specific to provide for the different conditions that may prevail in various sections. . . .

"It is, therefore, necessary that the orchardist and gardener be able to judge, at times, for themselves when danger from frost is imminent. For this purpose they should be provided with a wet and dry bulb hygrometer or psychrometer, by which the dew-point of the air can be determined.

"If, in the afternoon, the dew-point is near the critical temperature, arrangements should be made for protecting, if necessary. If, at a later hour, the dew-point is constant or lower, the sky clear or clearing, and the air calm, it is reasonable to expect that the temperature will fall to the dew-point during the night. The efforts to protect should be based on this dew-point. If it merely approximates the danger point (and no warning of more severe temperatures has been received) but little protection will be necessary, and action may be delayed until the temperature is but a few degrees above the danger point. However, if the dew-point be several degrees below that liable to cause injury, or if it be falling, or if a change for the colder is anticipated, efforts to protect should be undertaken earlier. The ground should be irrigated during the day, smudge fires started when the temperature is several degrees above the critical point, and, if the temperature continues to fall, the fires should be sprayed until dense fog or mist envelopes the entire space. If the temperature should then fall to the danger point, the trees and plants should be thoroughly sprayed, at the same time keeping up the smudge and vaporizing fires.

"It would seem that these precautions should be sufficient to prevent injury, unless it be in the case of narrow valleys, where the cold air from the unprotected hillsides displaces that which has been kept warm, and, should wind-breaks be found successful in removing this danger, it is believed that there are few, if any, localities where injury could not be avoided."

Departures from normal temperature and rainfall, with crop yields, in Nebraska, H. H. C. DUNWOODY (*U. S. Dept. Agr., Weather Bureau, pp. 30, charts 10*).—This is a series of diagrams accompanied by explanatory notes "exhibiting the departures from normal temperature and rainfall, and also the variations from the average yield of corn, wheat, oats, potatoes, and hay in Nebraska for each year from 1886 to 1895, inclusive. . . .

"In the construction of the diagrams, data have been used from 8 stations so distributed as to best represent the actual conditions which existed over the central and eastern portions of the State, the most important agricultural districts.

"With records presented in this form, the farmer may compare the current weather conditions, as the season advances, with the corresponding periods of previous years, and thus be enabled to determine some time in advance of harvest the probable effect upon his crops."

Climate and Health, W. F. R. PHILLIPS (*U. S. Dept. Agr., Weather Bureau, Climate and Health, 2 (1896), No. 1, pp. 35, charts 14*).—"Climate and Health is intended to be a repertory of statistical and other information appertaining to climatology and its relations to hygiene, from which persons interested in the subject of the influence of climate and weather upon health may obtain data for making comparisons to determine the relative therapeutic and hygienic merits of different climates, for the prosecution of original researches, and whatever other uses and purposes to which they may find the information applicable . . .

"This number contains climatologic, morbidity, and mortality statistics for the 5 calendar weeks embraced between December 29, 1895, and February 1, 1896, inclusive. The climatologic statistics are taken from reports of the regular stations of the Weather Bureau, and the morbidity and mortality statistics from special reports contributed by physicians and health officers directly to the Weather Bureau."

A scientific lightning rod, W. A. ANTHONY (*Rural New Yorker, 55 (1896), No. 2432, p. 597*).—The author recommends for a ground connection in moist earth a plate of copper or galvanized iron presenting a surface of 6 or 8 sq. ft., with the end of the rod wired and firmly soldered to it. The rod itself would best be a cable of copper or galvanized iron wire. Size of conductor will depend on exposure and surroundings. For an isolated building on an elevation, with no trees near, $\frac{3}{16}$ in. galvanized iron cables would suffice, and enough of them should be used to furnish an ample path for any possible discharge. They should all be connected, the sharp points of the upper end extending above chimneys. No insulators should be used.

Meteorological observations, L. METCALF and J. L. BARTLETT (*Massachusetts Hatch Sta. Met. Buls. 88 and 89, pp. 4 each*).—The usual summary of observations at the meteorological observatory of the station during April and May, 1896.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 23 (1895), Nos. 10, pp. 365–407, charts 6; 11, pp. 409–448, charts 7, figs. 9; 12, pp. 449–487, charts 7, pl. 1*).—Besides the usual summaries of observations at over 2,500 stations, No. 10 contains special articles upon the earthquake of October 31, 1895, by C. F. Marvin; photographing lightning by daylight, by A. J. Henry; and notes by the editor on the great storm of October, 1896, in the Gulf of California,

time reckoning, droughts and the weather in distant regions, the extent of a local rain, lightning flashes by pairs, the nor'westers of Canterbury, and the movement of thunderstorms against the wind.

No. 11 contains an article on weather types of the north Pacific Slope by B. S. Pague, an illustrated description by C. F. Marvin of a kite used in observations by the Bureau, and an article on the fluctuation of the water level in the Great Lakes by O. Guthrie, besides notes by the editor on the chemical storm glass, evaporation, a wave of darkness, long-range forecasts in Oregon, movement of thunderstorms against the wind, penetration of snow by bullets, ancient climates near Chicago, storm wave at Sausalito, sunshine, drought and agriculture, and chinook in Montana.

No. 12 contains a special article on Thomas Jefferson as meteorologist by F. J. Randolph and F. J. Francis, and notes by the editor on meteorology in the public schools, the general circulation of the atmosphere, the present condition and recent progress of climatology, fog in New York harbor, possible advances in the weather service, frosts in southern California, snow rollers, and movement of thunderstorms against the wind.

Report of the fourth annual meeting of the American Association of State Weather Services (*U. S. Dept. Agr., Weather Bureau Bul. 18, pp. 55*).—This is a report of a meeting held at Indianapolis, Indiana, October 16 and 17, 1895, and includes an account of the proceedings, report of the committee appointed to investigate the stamping of weather forecasts on mail matter, and the following special articles: Biographical sketch of Increase Allen Lapham, by Julia A. Lapham; importance of static electricity in Weather Bureau work, by E. A. Beals; how best to secure and retain the services of voluntary observers, by Mrs. L. H. Greenewald; State weather services—their importance and equipment, by A. J. Mitchell; history of the southern California weather crop bulletin, by G. E. Franklin; and discussion of topics, by C. F. von Herrmann.

Journal of the Scottish Meteorological Society (*3d ser., vol. 10, No. 11 and 12, pp. 202, charts 2*).—This includes reports of the meetings of the society and the following special articles: The high temperature of September, 1895, and the Ben-Nevis observatories, by A. Buchan; hygrometric researches at high and low levels, by A. J. Herbertson; on the diurnal range of temperature variability at the summit and base of Ben-Nevis, Lady Franklin Bay, and Hong Kong, by R. C. Mossman; on sunshine with different winds at Edinburgh, by R. C. Mossman; and the frost of 1895 in Scotland, by R. C. Mossman. Observations on rainfall at Scottish lighthouses in 1893 and 1894 are also reported, and detailed data on the meteorology of Scotland during the same years are tabulated.

WATER—SOILS.

Geological history of the Chautauqua grape belt, R. S. TARR (*New York Cornell Sta. Bul. 109, pp. 89–122, figs. 23*).—This bulletin recounts the results of geological and topographical studies made for the purpose of ascertaining the natural conditions which favor fruit growing in the grape belt of the Erie shore of New York. The situation of the grape belt is described as follows:

"From Lake Ontario southward, toward Niagara Falls or Lockport, there is a nearly level plain extending to the base of the Niagara escarpment, known locally as 'the mountain' which rises quite abruptly to a height of 200 or 300 ft. This escarpment is well seen at Lewiston, where the basal plain stretches away toward the lake, with scarcely any diversity to break the monotony. All of this plain is less than 500 ft. in elevation above the sea, and it borders the entire southern shore of Ontario.

"South of the Niagara escarpment, toward Batavia or Buffalo, there is another plain, which beyond Buffalo narrows down to a width of only one or two miles as the State line is approached. It is nowhere below 500 ft. nor above 800 ft. in elevation. This narrow strip which borders the Erie shore is the true grape belt. Everywhere the southern margin of this plain is backed by an escarpment or ridge, which quickly rises to a height of 500 or 600 ft. above the plain, and in some places is over 1,000 ft. above the lake. Therefore, the grape belt (in New York) is a narrow plain extending northeastward from the Pennsylvania State line, and bounded on the north by the lake, on the south by a high range of hills. East of Silver Creek the plain widens, and the bounding escarpment loses in elevation. This narrow plain is only a small fragment of the real plain, for the waters of Lake Erie cover the greater part of it. Indeed, the plain descends beneath the lake waters and ascends on the Canadian side. Not merely is a part of the plain now submerged, but at a recent geological period more of it, and that part now occupied by the most flourishing vineyards, was covered by the lake waters. Lake Erie now plays an important part in modifying the climate of the grape belt; it formerly did important service in modifying the soils."

The bed rock underlying this region is upper Devonian shales and sandstones above the horizon of the Hamilton, as revealed along the lake shore and in gorges cutting the escarpment and plain. The soils from south to north across the grape belt vary sometimes in details, but in general are as follows: Commencing on the hillsides with a thin pebbly, clayey soil, at the bases of the hills, perhaps 250 ft. above the lake, a gravelly soil with water-rounded pebbles is found. Going on north ensues a steep slope of 20 to 30 ft., at the base of which is clay continuing for several hundred feet or yards, when gravel again appears. Then come one or two gravel terraces with clay at the bases, and the descent from these to the lake is made over a clayey soil sometimes mixed with sand. The shore is usually a shale or clay bluff, though sometimes a sandy beach. Throughout the entire grape belt there are 3 distinct gravel areas in the shape of level-topped terraces extending approximately parallel to the Erie shore. Upon these gravel regions the best vineyards are located. The gravel is usually about 15 ft. in depth over clay or shale.

The methods of geological deposition of these graveled areas and of the till or bowlder clay of the hillside soils are discussed. The hillside soils have proven of least value for grape and fruit raising. The characteristic features of the modern beaches of Lake Erie are described and illustrated, and the ancient beaches, as set forth by the gravel regions, are compared with the modern and the close resemblances pointed out. The number of gravel regions, representing ancient beaches, varies from 1 to 5 in the grape belt, though there are usually 3 as before stated.

The bulletin concludes with a résumé of the geological history of this part of New York, stating that the glaciers of the ice age are chiefly responsible for the present condition of affairs. The climate of the grape belt is stated to be of even greater importance in the success of vineyards than is the soil itself. This to a great extent is controlled by the lake, which in spring by its low temperature holds back the

vegetation until danger from frost is past, and in the fall as a warm body of water lengthens the growing season by its near influence.

Available potash and phosphoric acid in soils, T. B. Wood (*Jour. Chem. Soc., 1896, Apr., pp. 287–292*).—This is a report of tests according to Dyer's method of the soil of the experimental plats of the Norfolk Chamber of Agriculture and of Suffolk County Council, used for comparative tests of fertilizers on barley (5 plats), ruta-bagas (3 plats), and other crops.

The soils used in the tests for potash are divided into 2 groups, (1) those on which the addition of potash produced only a small increase in the yield of barley, $1\frac{1}{6}$ bu. per acre, and (2) those on which an equal addition of potash produced a large increase in yield, from 22 to 45 bu. The amount of potash in these soils soluble in hydrochloric acid (1 part of acid to 1 of water) and in 1 per cent citric acid was determined, showing that while all of the soils were well supplied with potash there was twice as much available potash in the soils of group 1 as in those of group 2, a result agreeing well with the results of the fertilizer experiments.

The soils of 3 plats planted to ruta-bagas (Swedes) and which responded in different degree to applications of superphosphate was examined for total (soluble in nitric acid) and available (soluble in 1 per cent citric acid) phosphoric acid. The results agreed perfectly with those obtained in the field experiments, the method appearing to give even better results with phosphoric acid than it did with potash.

When the suggestion of Dyer "that in order to make the results strictly comparable for all soils sufficient citric acid should be added to neutralize all the chalk in the soils and leave 1 per cent over" was followed it was found that "the amount of potash dissolved was nearly equal in the case of each of the 3 soils tried, and the amount of phosphoric acid dissolved increased rapidly as the percentage of lime increased."

In the author's opinion the clearest indication of the amount of available potash and phosphoric acid is obtained by extracting with 1 per cent citric acid without regard to the amount of lime in the soil and that by so doing the analyst is imitating more closely the conditions under which plants obtain their potash and phosphoric acid than in the other method, since "there is no evidence to show that the acidity of the root juice is greater when the soil is more calcareous."

The rapid and exact determination of lime in arable soils, A. Nantier (*Ann. Agron., 22 (1896), No. 5, pp. 245, 246*).—Five grams of soil is placed in a glass flask with 50 cc. of nitric acid (100 cc. of which saturates 5 gm. of pure calcium carbonate) and boiled 4 or 5 seconds to drive off carbonic acid. Fifty cubic centimeters of cold water and a few drops of litmus are then added and the excess of acid titrated with a solution of soda of the same strength volume by volume as the nitric acid used.

The composition of water, T. C. WARRINGTON (*Chem. News, 73 (1896), pp. 137, 145, 156, 158, 184*).—A short bibliography.

Analyses of the artesian waters of New South Wales and their value for irrigation and other purposes, J. C. H. MINGAYE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 5, pp. 316–327*).

Composition of the soil adhering to beets, PELLET (*Sucr. indigéne, 47 (1896), p. 603*).

Some points on the constitution of soils, CHURCH (*Agl. Students' Gaz., 8 (1896), No. 1, pp. 1–4*).—An abstract of a lecture.

The amounts and different degrees of solubility of the fertilizing materials in different agricultural soils, J. HANAMANN (*Casopis pro prûmysl chemicky, 6 (1896), pp. 117–157*).

Influence of the nature of the soil on the different crops, L. GRANDEAU (*Jour. Agr. Prat., 60 (1896), II, Nos. 30, pp. 113–115; 31, pp. 151–154*).

FERTILIZERS.

The action of muriate of potash on the lime resources of the soil, C. A. GOESSMANN (*Massachusetts Hatch Sta. Bul. 38, pp. 14–16*). It had been observed that crops grown on the experimental plats of the station which had received applications of muriate of potash for a number of years in succession were unhealthy in appearance, and it was suspected that this condition was due to a loss of lime from the soil. Five to six hundred pounds per acre of lime "was applied broadcast early in the spring, and subsequently plowed under before preparing the soil for manuring and seeding. The succeeding crops of oats looked healthy from the beginning to the end of the season." The drainage water from the plats was collected and examined. A much larger amount of lime was found in the water from the plats which had received muriate of potash than from those to which sulphate of potash or other fertilizers had been applied. Calcium chlorid was present in liberal amounts. The conclusion is reached that a liberal use of muriate of potash should be accompanied by periodical applications of lime, and that it is safer to use this salt on a deep soil with a permeable subsoil than upon a shallow soil with compact subsoil, since in the latter case harmful chlorids are likely to accumulate near the surface to the injury of the roots of the plants.

Cost of nitrogen, phosphoric acid, and potash in Connecticut during the spring months of 1896 (*Connecticut State Sta. Bul. 122, pp. 3–8*).—A review is given of the fertilizer market showing the retail cash cost of nitrogen, phosphoric acid, and potash in various unmixed materials.

The results are summarized in the following table:

Cash retail cost per pound of nitrogen, phosphoric acid, and potash in Connecticut.

[Spring months, 1896.]

	Minimum.	Maximum.	Average.
Nitrogen.	*Cents.*	*Cents.*	*Cents.*
Nitrate of soda	12.7	15.0	14.20
Sulphate of ammonia	15.5	16.8	16.20
Prime hulled cotton-seed meal	11.2	15.5	12.70
Unhulled cotton-seed meal	14.3	16.8	15.50
Linseed meal	12.3	13.7	12.90
Castor pomace	15.5	18.2	17.00
Dry fish	11.4	16.6	14.50
Available phosphoric acid.			
Dissolved boneblack	5.9	7.4	6.60
Acid phosphate	4.2	6.6	4.80
Potash soluble in water.			
Muriate of potash	3.9	4.3	4.16
High-grade sulphate	4.9	5.2	5.10
Low-grade sulphate	4.9	6.3	5.60
Cotton-hull ashes	3.8	10.9	6.60
Ground tobacco stems	5.7	8.8	7.30

Wisconsin's fertilizer law, W. A. HENRY (*Wisconsin Sta. Bul. 47, pp. 6*).—The text of the law which was passed by the legislature of 1895 and which went into effect December 1, 1895, is given, with notes on the value and importance of commercial fertilizers and the need and advantages of State supervision and control of the industry.

The principal provisions of the law are as follows: All goods selling for $10 or more per ton are subject to the law; each package must bear besides the usual statement of weight, name of brand, name of manufacturer, etc., a guaranty of "the percentage of nitrogen in an available form, the percentage of potash soluble in water, and the percentage of available phosphoric acid, soluble and reverted, as well as total phosphoric acid;" a sealed sample of not less than 1 lb. sworn to "correspond within reasonable limits to the fertilizers which it represents," and accompanied by a copy of the statements to be used on each package is to be sent to the Director of the Wisconsin Experiment Station between December 1 and 31, who is to analyze these samples, and report the results in a station publication on or before April 1 following; the director's certificate of compliance with the provisions of the law constitutes a license for sale, and for this the manufacturer or dealer must pay into the station treasury an annual fee of $25 for each brand put on the market. The sale of additional brands may be provided for during the year by filing samples, affidavits, etc., as above, 1 month before the fertilizers are put on the market and by paying a fee of $50. The director, or his deputy, is authorized to take samples, under the usual restrictions, of any fertilizers offered for sale in the State, and to analyze them and report the results; and he is also duly empowered to enforce the provisions of the act and prosecute violations of the same.

Analyses of commercial fertilizers, J. L. HILLS, B. O. WHITE, and C. H. JONES (*Vermont Sta. Buls. 50, pp. 8; 51, pp. 11–19; 52, pp. 23–43*).—Trade values of fertilizing materials in Vermont during 1895–'96 with notes on valuation, statements regarding the collection of samples, a comparison of values of fertilizers licensed in 1895 and 1896, and tabulated analyses and valuations of 232 samples of fertilizers.

"The station has analyzed samples of 110 distinct brands of fertilizers, all taken this spring from dealers' stocks and all this year's goods. This is 18 more than were analyzed in 1895 and 57 more than in any year previous to that time.

"Of 110 brands analyzed, 70 (nearly two-thirds) were above guaranty throughout. Of the 40 deficient brands, 21 were but slightly short in a single ingredient, but 3 were lacking in two ingredients, and but one was seriously deficient. Practically five-sixths of the brands sold in Vermont this year are equal to or better than guaranties, and 99 per cent are commercially equivalent to guaranties. In no year previous have so good results been obtained.

"The average composition of 71 brands sold in Vermont in 1895 and 1896 shows a slightly better quality this year and an increase of 40 cts. in valuation. Prices are a little less, but have not dropped in proportion to the lessened cost of crude stock. The increase of cost over valuation of the average goods is 57 per cent, the highest since the station begun to execute the State law 10 years ago. Yet plant food is as cheap to-day to the farmer as it has ever been. If former prices were fair, however, it should be cheaper now than ever before."

The following table shows the average composition, selling price, and station valuation of all the fertilizers analyzed each year since the station took charge of the State inspection of fertilizers:

Average composition and value of fertilizers, 1885–'96.

	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
Nitrogen	2.38	2.58	2.75	2.80	2.55	2.41	2.52	2.42	2.41	2.21	2.22	2.22
Soluble phosphoric acid	6.35	6.15	5.48	6.74	6.68	5.99	6.47	6.47	6.44	5.42	5.84	5.36
Reverted phosphoric acid	1.93	1.92	3.23	2.80	2.97	2.97	2.86	2.60	2.84	2.97	2.56	3.44
Insoluble phosphoric acid	2.13	2.59	2.52	2.56	2.98	2.71	2.00	2.18	2.34	2.16	2.53	2.22
Available phosphoric acid	8.28	8.07	8.71	9.54	9.65	8.96	9.33	9.07	9.28	8.39	8.40	8.80
Total phosphoric acid	10.41	10.66	11.23	12.10	12.63	11.67	11.33	11.25	11.62	10.55	10.93	11.02
Potash	2.77	2.69	2.84	3.12	2.69	3.16	3.13	2.82	2.64	2.95	3.46	3.66
Average selling price	$37.90	$37.02	$36.75	$35.13	$35.11	$34.39	$33.14	$32.47	$32.32	$31.47	$30.90	$30.90
Average valuation by each year's price	26.72	25.75	27.15	28.96	29.05	26.70	26.07	24.48	23.53	21.47	21.28	19.73
Per cent increase of cost over valuation	42.00	44.00	35.00	21.00	21.00	29.00	27.00	33.00	37.00	47.00	45.00	57.00
Valuation by 1896 prices	18.92	19.32	20.53	21.80	21.07	20.26	20.65	19.91	19.99	18.63	19.32	19.73

Agricultural manures and the principles underlying their use, LOXLEY MEGGITT (*Nottingham: R. B. Earp & Sons, pp. 31*).

On the management of human excreta in the country, J. H. VOGEL (*Mitt. deut. landw. Ges., 11 (1896), No. 16, pp. 169–171*).

On liming, HOLDEFLEISS (*Mitt. deut. landw. Ges., 2 (1896), No. 13, pp. 143–145*).

The proper use of tables of analyses of fertilizers and fertilizer chemicals, E. H. JENKINS (*Connecticut State Sta. Bul. 122, pp. 9–16*).—This is a brief popular summary of information on the factors of crop production and on the character of the various fertilizing materials found in the market, designed to aid the farmer in a rational use of fertilizers and in understanding and utilizing "the analyses of commercial fertilizers and fertilizer chemicals which are yearly published by the station."

Fall fertilizers, MAIZIÈRES (*L'Engrais, 11 (1896), No. 36, pp. 852, 853*).—An argument in favor of phosphates as the fertilizer *par excellence* for fall application.

Fertilizer experiments with Bremer poudrette, SCHULTZ-LUPITZ (*Mitt. deut. landw. Ges., 11 (1896), No. 16, p. 169*).

The use of commercial fertilizers on winter grain, VON BOUSMANN (*Fühling's landw. Ztg., 45 (1896), No. 17, pp. 545–549*).

Commercial fertilizers, C. A. GOESSMANN (*Massachusetts Hatch Sta. Bul. 38, pp. 3–11*).—A brief general discussion on fertilizers is given, with notes on valuation and analyses of 24 samples of fertilizing materials, including cotton-hull ashes, cotton-seed meal, linseed meal, bone, Florida soft phosphate, ashes from garbage crematory, soft coal ashes, cotton waste, card waste, a liquid fertilizer, sheep fertilizer, and hen manure.

Analyses of commercial fertilizers, T. J. EDGE and W. FREAR (*Pennsylvania Dept. Agr. Bul. 11, pp. 21*).—This includes the text of the State fertilizer law, notes on valuation, and tabulated analyses and valuations of 257 fertilizers collected in Pennsylvania during the period from January 1 to August 1, 1896.

Analyses of commercial fertilizers (*South Carolina Sta. Bul. 24, n. ser., pp. 15*).—This includes a statement of commercial values of raw materials during the season of 1895–'96, and tabulated analyses and valuations of 109 samples of fertilizing materials, including acid phosphate, cotton-seed meal, kainit, and mixed fertilizers.

Commercial fertilizers, B. H. HITE (*West Virginia Sta. Bul. 40, pp. 159–185*).—This bulletin describes the different forms of phosphoric acid, explains briefly the value and management of farm manure, makes suggestions regarding the selection and valuation of fertilizers, gives the text of the State fertilizer law, and reports analyses of 317 fertilizing materials collected during 1894 and 1895.

Report of Oerebro Chemical Station and Seed-Control Station for 1894, J. WIDEN (*Oerebro (Sweden): 1895, pp. 48*).—The report contains the usual accounts of chemical and seed control work performed during the year. The following average analyses of fertilizers are given: *Superphosphates* (26 samples): Water-soluble P_2O_5 19.10 per cent (18.13 to 20.17), citrate and water-soluble P_2O_5 20.21 per cent (19.85 to 21.04); *Thomas slag* (18 samples): Total P_2O_5 18.18 per cent (16.09 to 21.06), citrate-soluble (Wagner's method) 13.90 per cent (11.23 to 15.93), fine meal 86.42 per cent (79.40 to 91.90); *kali-magnesia* (10 samples): K_2O 14.86 per cent (13.72 to 17.22); *kainit* (5 samples): K_2O 12.74 per cent (12.25 to 13.39).—F. W. WOLL.

FIELD CROPS.

Experiments on the variation in Hanna barley grown in different places, VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 10 (1895), No. 2, pp. 81–100*).—Among the points covered by the investigation were the weight per bushel, weight of 1,000 kernels, percentage of husk, character of the endosperm, content of protein and of extract.

The author says that the results corroborate those of earlier experiments, and it can be safely stated that with a heavy weight per bushel go a greater weight per kernel, a smaller percentage of husk, a richer content of extract, and finally a greater yield.

The velvet bean, O. CLUTE (*Florida Sta. Bul. 35, pp. 340–345*).—This bean was planted on a poor soil at distances of 1 foot in 3-foot rows. The vines grow from 10 to 20 feet long, yielding at the rate of 16,680 lbs. green forage per acre. The thick and leathery pods contained from 3 to 5 large beans irregularly colored with purplish and brownish patches.

An analysis showing food constituents is given.

In trials by two other cultivators the velvet bean is reported as valuable for green manuring in orange groves and for feeding to horses and cattle.

Flax, W. SAUNDERS (*Canada Exptl. Farms Bul. 25, pp. 11, figs. 3*).—This bulletin treats of the culture of flax, the amount and value of the flax crop in Manitoba and the United States, flax growing in Ontario for fiber, and of the exhaustion of the soil produced by the flax crop. The author states that "the difference in exhaustive effect of these several crops [wheat, oats, and flax] on a rich soil would scarcely be perceptible, and would not justify the opinion that flax is a very exhausting crop." When grown for fiber, flax is pulled at a cost of $4 to $5 per acre, the yield of fiber averaging 1½ tons, and of grain 8 to 9 bu. per acre. The average yield in Manitoba when grown for seed in 1895 was 15½ bu. per acre.

Experiments with lupines and other nitrogen gatherers, B. LARSEN (*Tidsskr. norske Landbr., 3 (1896), pp. 88–96*).—Experiments with lupines and other nitrogen-gathering plants were made on several Norwegian farms. The effect on potatoes and oats of a preceding lupine crop, either harvested or plowed under, and with or without application of commercial fertilizers, was studied during 1895.

Poor, sandy soil, unmanured for a number of years, was selected for the tests.

All of the 7 potato plats received an application of superphosphate and basic slag, and in addition nitrate and carbonate of potash, singly or combined, were applied on 4 plats, on 3 of which a crop of lupines was plowed under; on 1 plat without potassic fertilizers the entire lupine crop, on another the roots and stubble only, were turned under.

The 7 plats of oats were treated in a somewhat similar manner. The data are tabulated. The results indicate that the supply of nitrogen furnished by the crop of lupines plowed under was not sufficient to meet the requirements of the potatoes, since an additional allowance of nitrate of potash increased the yields obtained.

Infection experiments with lupine soil were made at 2 substations. Soil on which lupines had grown successfully was carted on to the land in quantities varying from 132 to 396 bu. per acre. The results are tabulated. The author considers 264 bu. per acre of lupine-infected soil ample to obtain a good stand of lupines, and 132 bu. will often prove sufficient. As the cheapest and most effective method of infecting a field to be sown to lupines the author recommends when sowing oats to add a small amount of lupine seed a year or two before growing lupines exclusively on the land.

In another experiment during 1895 oats, vetches, peas, and lupines were grown with and without fertilizers on land a portion of which was treated with lupine soil.

The results are tabulated. The author concludes that lupine infec-

tion does not aid the other legumes nor oats in their growth, while lupines gave a materially increased yield in all cases where lupine soil was added to the plats. These data indicate that the different leguminous plants require different symbiotic bacteria for their growth.—F. W. WOLL.

Experiments on pasture in 1896, E. K. (*Agl. Students' Gaz., n. ser., 8 (1896), No. 1, pp. 15-17*).—On 20 twentieth-acre plats rape meal, basic slag, farmyard manure, sodium nitrate, kainit, guano, superphosphates, and ammonium sulphate were applied alone or in combinations of 2 and 3. The manures were applied at dates between January and May. The composition of some of the fertilizers and the yields per acre are given. The average yield of all the plats was nearly 1 ton per acre. Mineral manures alone or nitrate of soda alone gave no increase or but a very slight one. Where mixtures of mineral and nitrogenous manures were applied the yields were greater. Usually ammonium sulphate gave better results than nitrate of soda. Generally the more complex the manure or the mixture the better the result on the first crop.

Comparative trial of oats, G. VAALDER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 3, pp. 135, 136*).—An account is given of a test at the Wagga Wagga experiment farm of 34 varieties of American oats for hay and grain. The seed was grown from oats obtained at the Chicago Exposition. White Baltic gave the largest yield per acre of hay, 2 tons 1 cwt., followed by Carter Prize Cluster, Early Dakota, and Early Egyptian, 1 ton 16 cwt. each.

The largest yield of grain was made by Early Red Texas, 77 bu. and 15 lbs. per acre (40 lbs. per bushel), followed by Red Rust Proof, Texas Rust Proof, White Bonanza, and Pringle Progress. The average yield of the 34 varieties was 38 bu. per acre.

Field experiments on oats (*Agl. Students' Gaz., n. ser., 7 (1896), No. 6, pp. 214-218*).—In the trial 24 tenth-acre plats were used. Three hundred pounds of kainit, 300 lbs. mineral superphosphates, 131 and 175 lbs. ammonium sulphate, 150 and 200 lbs. of sodium nitrate per acre were applied alone, and in combinations of 2 and 3; one plat received 7 and one 14 tons of barnyard manure per acre, and one remained unmanured.

The plats were plowed in February and sown April 10 to Black Tartarian oats. The rainfall for May and June was below the average. The yields are tabulated. The smallest yield, averaging $29\frac{1}{8}$ bu. per acre, was from plats receiving mineral superphosphate and kainit; the highest yield ($55\frac{3}{4}$ bu.) was from the plats receiving kainit, superphosphate, and mineral nitrogen, followed by the plats which had received 14 tons per acre of barnyard manure every year since 1865. The average yield of all the plats was equivalent to $40\frac{7}{8}$ bu. of grain and 1,975 lbs. of straw per acre, 23 bu. less than the previous year and less than one-half the yield of straw.

On a special method of planting potatoes, C. ALLIER (*Prog. Agr. et Vit., 13 (1896), No. 5, pp. 121–129*).—This is a continuation in 1895 of work carried on in 1892, 1893, and 1894. The following methods were compared: (1) Potatoes, large and small, were cut into pieces weighing 15 to 40 gm., with one or two eyes to the piece, and the cuttings planted 10 cm. (about 4 in.) apart in the row; (2) whole tubers of medium size were planted 50 cm. (about 20 in.) apart in the row; and (3) small whole tubers weighing 20 to 40 gm. were planted at 10 cm. in the row. In all cases the rows were 60 cm. (about 2 ft.) apart. The preparation of the soil, the manure, the depth of planting, and the cultivation were the same as in the ordinary methods.

The results of experiments at the station and of coöperative experiments of a similar character in different parts of France are tabulated and discussed. The author states that the largest yield was produced by the small tubers planted closely, a gain of 45 per cent over the yield of medium tubers at 50 cm. in the row; aside from this the largest yield with each of the 8 varieties tested was produced by the 1-eye pieces.

The cuttings gave a profit with all the varieties except one; the largest profit came from the small tubers closely planted, the gain over medium sized tubers being valued at 633 francs per hectare.

The results of the coöperative trials were of the same import.

In conclusion the author recommends a trial of the method of planting 1 and 2 eye pieces at 10 cm. distance, in comparison with the regular methods.

Concerning the influence of the starch content of the potato on the amount and quality of the yield, H. HITIER (*Jour. Agr. Prat., 60 (1896), I, No. 18, pp. 657, 658*).—In his experiments in 1892 A. Girard indicated clearly that the starch content of the seed tubers had no influence on the yield.

Beside cultural methods and meteorological conditions 3 factors take part in the production of large yields of potatoes—the hereditary qualities of the plant, its weight, and its content of substances capable of nourishing the young plant. Girard planted 53 lots of 2 tubers; each two were taken from the same hill, were of nearly equal weight but of different specific gravity, and were subjected to like conditions of soil and culture. In 15 cases only the tubers richest in starch gave the largest yields; in 20 cases the opposite result was obtained. In 1894, from 30 lots on trial, similar results were had.

In 1894 the middle row of 3 under trial was dug when partly grown, and all parts of the plants were weighed and analyzed; at the same time from one of the remaining 2 rows the seed tubers were carefully removed. When planted the seed tubers contained 13.83 per cent of starch and 2.09 per cent of nitrogenous substances; when removed they contained 4.56 and 0.99 per cent, respectively. The yield of the unmolested row was 7.336 kilos; of the row from which the seed tubers had

been removed, 7.222 kilos. The tubers in the former contained 11.16 per cent of starch, in the latter 11.8 per cent. Some of these potatoes had consumed 13 per cent of the starch in the seed; others 9 per cent.

The author concludes that the starch content of the seed tuber has no effect on either the amount or starch content of the yield.

Potato experiments, M. A. SCOVELL and C. W. MATHEWS (*Kentucky Sta. Bul. 61, pp. 3–13, 36–42*).—These experiments are in continuation of previous work reported in Bulletin 55 of the station (E. S. R., 7, p. 201).

Tests with fertilizers (pp. 3–13).—The potatoes used for seed were northern-grown Early Rose; these were immersed for ½ hour in a solution of corrosive sublimate, 3½ oz. to 30 gals. of water. The fertilizers were scattered by hand in the row, and slightly mixed with the soil before planting. Nitrate of soda, muriate of potash, and acid phosphate were used singly and in combinations of 2 and 3. The data are tabulated. The author concludes that both potash and nitrogen are needed for potatoes on the soil under experiment.

In a similar coöperative experiment reported, phosphoric acid seemed to be the element needed.

Varieties of potatoes (pp. 36–42).—Of the 241 varieties tested, about 2 lbs. each were cut into 20 pieces of nearly even size; these were planted April 15 in drills about 4 in. deep, pieces 16 in. apart in the row. Each variety occupied 80 sq. ft.

The seed previous to planting was treated with a solution of corrosive sublimate, 1 part to 1000 of water. The yields are tabulated.

Potatoes, L. FOSTER (*Montana Sta. Bul. 9, pp. 3–22*).—By way of introduction the methods of potato culture employed by several farmers in the State are given. May 10 and 11, 52 varieties of potatoes were planted on fall-plowed land, the seed pieces being dropped 13 in. apart in 3-foot rows and covered 4 in. deep. One irrigation was given when the potatoes were in bloom. The yields are tabulated. Potatoes were planted at depths of 2, 3, 4, 5, 6, 8, and 10 in. There was a constant decrease in yield with increase of depth. In a comparison of hills *vs.* drills, drills gave the larger yields. In a trial of seed cut 5 days before planting *vs.* seed freshly cut, the larger yields were obtained from the latter.

Potatoes, L. C. CORBETT (*West Virginia Sta. Bul. 41, pp. 190–206, fig. 1*).—Horse manure and lime, alone or in combination, were used on the manured portions of the land on which 35 varieties of potatoes were grown in 1894 and 62 varieties in 1895. The results are tabulated. Twenty-one of the 35 varieties produced larger yields in 1895 than in 1894; the 14 varieties showing a falling off in 1895 were mainly those most promising in 1894. Only 4 of the 35 varieties maintained an average yield of 170 bu. per acre during both seasons.

In treating the seed the advantage of using corrosive sublimate without lime and Bordeaux mixture with lime is spoken of. The lime

converts the corrosive sublimate into an oxid, which is of no value as an insecticide. Tabulated data are given of yields in a coöperative test of potatoes.

Studies of Norwegian potatoes of the crop of 1895, J. SEBELIEN (*Norsk Landmansblad, 15 (1896), pp. 157–161*).—Ninety-three samples of potatoes from 64 localities were examined by the author during 1895. Twenty-six samples contained 13.9 per cent of starch or less, 19 14 to 15 per cent, 17 15.1 to 16 per cent, 23 16.1 to 17 per cent, and 8 over 17 per cent. The highest starch content obtained was 20.1 per cent. About one-third of the samples received were Magnum Bonum potatoes. Experiments at Kalnaes Agricultural College gave results indicating a very beneficial influence from Bordeaux mixture, both on the yield and the quality of the potatoes grown (Magnum Bonum), shown as follows:

Effect of Bordeaux mixture on potatoes.

Date of planting.	Date of digging.	Times treated.	Yield per acre.	Starch content.
			Pounds.	*Per cent.*
June 6	Sept. 28	Not treated	1,426	Below 13.9
May 31	Oct. 2	Not treated	2,116	14.3
May 31	Oct. 3	Treated once	2,499	14.5
May 31	Oct. 3	Treated twice	2,858	16.3

—F. W. WOLL.

A study of the fertilizing materials used by the sugar beet, W. SCHNEIDEWIND and H. C. MÜLLER (*Jour. Landw., 44 (1896), No. 1, pp. 1–30*).—The authors treat the subject under the following heads: The ash content of the sugar beet; the ash content of the leaves; the function of potash and soda, lime, magnesia, phosphoric acid, chlorin, the plant acids, and nitrogen in the plant. Tabulated data show for the different varieties under trial, both when kainit was applied and when not, the sugar yield, percentage of sugar in the beet, percentage of ash, and the effect of the application of kainit on the content of nitrogen, potash, soda, lime, magnesia, phosphoric acid, and chlorin; also the effect of irrigation, and the composition of the dry substance.

In conclusion the authors state that the ash content of the sugar beet has diminished under cultivation, since a high sugar content corresponds with a low ash content. The ash content of the leaves has not been influenced.

The ash and nitrogen contents stand in inverse ratio to the sugar content. The potash content of the beets and leaves was increased by an application of potash; and a corresponding effect upon the soda content was produced by an application of soda.

Natural sugar in tobacco (*Kew Misc. Bul., 1896, No. 110, pp. 49–55*).—In connection with the duty on tobacco in England an investigation was made by H. Miller as to the sugar content of the dried and green

leaves. The presence of sugar in fresh tobacco was first ascertained by J. Nessler.[1]

At the wholesale houses 12 samples were selected from the original packages; these were all of a pale color and, except the Virginia, Kentucky, and Algerian, were known in the trade as "sun-dried" tobacco. The following is a list of the varieties with the percentages of sugar found: Algerian, none; Kentucky, none; Greek, a trace; Turkish, 2.3; Syrian, 2.8; Chinese, 3.5; Virginia leaf, 3 samples, 5.4, 7.2, and 9.8; Bright Virginia, 3 samples, 10.6, 12.5, and 15.2 per cent. A repetition of the experiment confirmed the above results.

The samples of green leaves from Kew analyzed were from 10 varieties of 2 principal species, *Nicotiana tabacum* and *N. rustica*, "the former being the one chiefly cultivated in America, whilst the latter seems to furnish most of the Oriental tobaccos." The following list contains the names of the varieties and the percentages of sugar found: *Nicotiana texana* var. *rustica*, 1.5; Shiraz, 4.6; *N. rustica*, 4; *N. tabacum* var. *virginiana*, 2.3; Maryland tobacco, 5; *N. tabacum*, 6.2; Bhilsa tobacco, 3.5; *N. tabacum* var. *attenuata*, 3.2; *N. gigantea*, 4.2; *N. macrophylla purpurea*, 4.5.

The author says: "Although I have in the foregoing shown that a very considerable quantity of saccharine matter may be present in certain kinds of tobacco as a natural constituent, I had no means of proving that so large an amount as 15 per cent (the quantity I found in the best Bright Virginia leaf) was produced by the plant itself." He found that in the yellow tobacco the amount of matter soluble in water varied within small limits, and concludes that "the addition of even a small percentage of sugar to tobaccos of this class would upset the average proportion of soluble and insoluble matter, unless a proportionate amount of soluble matter had been previously removed."

Experiments with wheat, oats, and fertilizers (*An. Rpt. School Agr., Stellenbosch; reprinted in Agl. Jour. Cape Colony, 9 (1896), No. 10, pp. 238–240*).—Variety tests were made with wheat. Smith Nonpareil, Fluorspar, Anglo-Australian, Pringle Defiance, and Marshall No. 22 were satisfactory.

Stable manure proved to be a much more economical fertilizer than artificial potato manure. Artificial manures applied to crops cultivated during the growing season only proved remunerative with copious irrigation.

Notes on the threshing of wheat, N. A. COBB (*Agl. Gaz. N. S. Wales, 7 (1896), No. 4, pp. 204–208*).—In 1893 36 varieties, in 1894 460 varieties, and in 1895 nearly 1,000 varieties were tested. Bags containing a given quantity of heads received a uniform number of blows, when the contents were emptied and the results determined.

The nature of the chaff determines the ease or difficulty of threshing. If it clings closely to the grain, the wheat threshes hard. Lists

[1] Der Tabac, seine Bestandtheile und seine Behandlung. Mannheim: 1867.

are given of 8 wheats that thresh very easily, 76 that thresh easily, 88 rather easily, 104 rather hard, 42 hard, and 6 very hard.

The author concludes as follows: The hard or maccaroni wheats, of which Medeah and Belotourka may be taken as types, are harder to thresh than the soft wheats. The Poulard wheats, of which the Algerian and Mummy may be taken as types, also thresh with greater difficulty than the soft wheats. Weak straw and earliness or lateness of ripening are of no value as an indication of ease in threshing. Velvet-chaffed wheats, whether bearded or beardless, thresh harder than the corresponding smooth-chaffed sorts. Wheats with crowded heads are generally harder to thresh, other things being equal. Red-chaffed wheats, with few exceptions, are easier to thresh than white-chaffed sorts. Bearded wheats, other things being equal, are easier to thresh than beardless sorts.

Crop conditions at Stend Agricultural School, Norway, 1886–1895, O. SANDBERG (*Landmandsvennen, 3 (1895), pp. 138–140*).—The school is located at Stend, near Bergen, Norway (latitude 60° 24′ N., longitude 5° 18′ E.). The following summary shows the dates of sowing and harvesting barley and oats, amount of seed used, yields obtained, etc.:

Average data for barley and oat culture in Norway were as follows: Date of sowing, oats May 5, barley May 6; germinating period, oats 12 days, barley 8 days; date of harvesting, oats September 4, barley August 14; growing period, oats 119 days, barley 111 days; amount of seed sown, oats 0.53 bu., barley 0.57 bu.; yield per acre, oats 52.8 bu., barley 39.2 bu.—F. W. WOLL.

On recent breeding of cultivated agricultural plants (*Braunschw. landw. Ztg., 64 (1896), No. 34, pp. 139, 140*).—The author describes his experience in increasing the productive capacity of wheat by improved methods of culture and by cross-fertilization. In the latter case he used a square head variety as the staminate parent for crossing with the ordinary varieties of German wheat.

Alfalfa, flat pea, and sachaline, O. CLUTE (*Florida Sta. Bul. 35, pp. 351–354*).—Alfalfa sown on sandy land, well fertilized, proved a failure. Sowings of the flat pea (*Lathyrus sylvestris*) also failed. A planting of sachaline (*Polygonum sachalinense*) grew vigorously. The foliage was readily eaten by stock.

Beets at the experiment station at Capelle, F. DESPREZ (*Jour. Agr. Prat., 60 (1896), II, No. 34, pp. 274, 275*).

Cañaigre (Rumex hymenosepalus), O. CLUTE (*Florida Sta. Bul. 35, pp. 349–351*).—An account of the planting and growth at the station of a few roots of cañaigre. The seed ripened in May.

Prickly comfrey (Symphytum officinale), O. CLUTE (*Florida Sta. Bul. 35, pp. 345, 346*).—A few roots were planted in the spring of 1895, and grew well; the leaves were green all winter. The roots are fleshy and run deep into the soil. The plant does very well on light lands. Stock learn to be fond of the leaves.

Corn and the sorghums, F. D. COBURN (*Rpt. Kansas State Bd. Agr., March 31, 1896, pp. 232*).—This is a popular pamphlet treating of corn, its cultivation, handling, utilization, cost, and values, more especially from a Kansas standpoint; the sorghums, their cultivation and value for grain and forage, estimated by Kansas growers and feeders, and a report of the twenty-fifth annual meeting of the Kansas State Board of Agriculture.

Experiments with foreign cotton, P. H. MELL (*Alabama College Sta. Bul. 71, pp. 299-307*).—Beginning in 1893 the station has been experimenting with foreign varieties of cotton. Twenty-one varieties were grown in 1895, 5 of which were Mexican, and the remainder from Egypt and India. A list of varieties and a botanical classification of cotton are given.

Cotton, its cultivation and fertilization, A. A. PERSONS (*Florida Sta. Bul. 32, pp. 201-204*).—This is a popular article on the planting, manuring, and cultivation of cotton.

Cotton, P. N. LAHIRI (*Indian Agr., 21 (1896), No. 7, p. 202*).—A popular article on cotton raising in India.

Report on certain Indian fibers, F. A. ABEL (*Agl. Ledger, 1896, No. 6, p. 3*).—This article treats of *Hibiscus abelmoschus*, *Malachra capitata*, and *Abroma angusta*.

Concerning jute, F. RITTER VON HÖHNEL (*Schriften Ver. Verbreit. naturw. Kennt. Wien, 35 (1895), pp. 31-60; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2-3, pp. 208, 209*).—Jute is produced from several nearly related sorts of Corchorus, especially *C. capsularis*. The different species of Corchorus grow to a height of 4 to 6 meters and furnish the longest of all bast fibers. They require a moist climate and high temperature for their development. Bengal produces about four-fifths of all the jute grown in the world. The yield in Bengal averages 1,500 kg. per hectare.

Kafir corn, C. C. GEORGESON (*U. S. Dept. Agr., Farmers' Bul. 37, pp. 11, fig. 1*).—This is a popular bulletin treating of the characteristics, culture, uses, and varieties of Kafir corn; of the soils and climate adapted to it; preparation of the soil; methods of seeding, cultivation, and harvesting; of the yield and composition; and of practical feeding tests with the grain. Kafir corn yields best on rich land, and is especially adapted to the regions in the semiarid West, where corn succeeds only once in 5 or 6 years. So far experiments have not shown the grain to be equal to corn as food.

Millet, G. VAALDER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 3, pp. 132-135, pls. 3*).—Notes are given on the growth at the Wagga Wagga experiment farm of 7 varieties of millet. German millet (Salzer Dakota) yielded at 3 cuttings 10 tons and 13 cwt., and Pearl millet 18 tons and 5 cwt. of green fodder per acre.

Irish potatoes, C. L. NEWMAN (*Arkansas Sta. Bul. 38, pp. 16*).—This is a popular article on potato raising, including selection and preparation of the soil, manures and fertilizers, planting, cultivation, varieties, digging, and marketing for both spring and fall grown potatoes; also remarks on potato scab, blight, and rot, and the potato beetle.

Recent observation on the cutting of potato tubers, A. GIRARD (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 428-439*).—The system of Allier of planting single eyes was compared with that of planting whole tubers. The latter gave a gain of 47 per cent in weight over the former.

Recent investigations on the influence of the starch content of potatoes on the crop, A. GIRARD (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 440-452*).—As a result of his investigations the author concludes that it is not worth while to sort out the tubers richest in starch for planting.

Improvement of potato culture, A. GIRARD (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 453-466*).—A report of coöperative trials. Eighty-seven yields are tabulated for 1894 and 1895.

Ramie in Jamaica (*Bul. Bot. Dept. Jamaica, n. ser., 3 (1896), No. 7, pp. 149-151*).

Rice cultivation in Tennessee (*From Northern Agriculturist; Sugar Cane, 28 (1896), No. 325, pp. 421, 422*).—An account of the successful growing of rice in the overflowed and unreclaimed land along the Mississippi.

Experiments with seed mixtures of rye and oats, VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 10 (1895), No. 2, pp. 122-127*).—On 13 plats oats were sown alone, and with 10, 30, and 50 per cent of barley added. The mixture yielded more grain and less straw than the pure oats. The differences in the yields of the mixtures were insignificant.

The culture of wheat on a loam soil, L. GRANDEAU (*Jour. Agr. Prat., 60 (1896), II, No. 35, pp. 296–300*).—An account of experiments at Jommelières with applications on wheat of superphosphates, and increasing amounts of chlorid of potash and nitrate of soda; also phosphatic slag. No definite results were obtained.

The spontaneous combustion of hay and its prevention, L. HÄPKE (*Abhandl. Naturw. Ver. Bremen, 13 (1895), No. 2, pp. 337–341; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, p. 214*).—Spontaneous combustion is more common in damp hay than in dry. If the inner temperature rises above 122° F., or smoke appears, application of water is the only remedy. The bacteria which cause spontaneous combustion are aërobic, and as far as possible access of air to the affected mow or stack should be prevented.

A study of rotations, A. PREISS (*Deut. landw. Presse, 23 (1896), Nos. 69, pp. 612, 613; 71, p. 630, dgm. 1; 72, p. 640*).—The rotations recommended are for the climates of Germany and for the different sorts of soils and cultures practiced there.

Report on field experiments for the year 1895 (*Agl. Dept. University College, North Wales, pp. 49*).—A report on coöperative experiments carried on at nearly 40 centers situated in 5 different counties, embracing about every variety of soil. These experiments "are not usually arranged with the object of discovering something absolutely new, but meant rather to act as object lessons." The experiments reported embrace fertilizer tests on turnips, meadows, and pastures, and on seeding to oats and to grass.

Cultural experiments instituted by the Schleswig-Holstein Agricultural Society in 1893-'95, TANCRÉ (*Landw. Wochenbl. Schles.-Holst., 46 (1896), Nos. 18, pp. 271–276; 19, pp. 292–295*).—In trials with catch crops and forage crops, white mustard, oil rape, crimson clover, sand vetch, lupines, and serradella were grown. As a plant for gathering nitrogen and enriching the soil serradella is of particular advantage when preceding grain crops or potatoes.

The author discusses the manurial requirements of the potato crop for that region, and mentions the constant degeneracy of varieties of potatoes and the continual need of replacing the failing varieties with established and fruitful ones of recent breeding. In a variety test the 6 varieties producing largest yields were Early May Queen, Magnum Bonum, Cösternitzer, Saxonia, Buntköpfige, and Prof. Maercker.

Burdwan experimental farm (*Indian Agr., 21 (1896), No. 4, pp. 108–110*).—The farm consists of 21 acres of sandy loam. In a series of fertilizer trials in which cow manure, castor cake, bone meal, and nitrate of potash were used the highest yields per acre were as follows: Winter rice, 4,673 lbs., and rice straw, 6,377 lbs., from an application of bone meal and nitrate of potash; and jute, 1,721 lbs., from an application of cow manure. The largest return of sugar on 6 twelfth-acre plats of sugar cane followed an application of bone meal. The largest yield of potatoes, 19,030 lbs. per acre, grew where cow manure had been applied. The potatoes were remarkably good in quality.

Seebpore experimental farm (*Indian Agr., 21 (1896), No. 4, pp. 110–112*).—The farm consists of 26 acres of heavy alluvial loam.

In a potato experiment on 8 tenth-acre plats, 3 were green manured with dhainche (*Sesbania aculeata*), 3 with castor cake, and the remainder with the two preceding combined; these were planted to potatoes in the last part of November. The crop was gathered in March. The doubly manured plats gave the largest yields, followed by those to which castor cake had been applied. In an experiment with castor cake *vs.* crude potassic nitrate on cabbages the largest returns were from applications of the former.

An experiment in rattooning the khari sugar cane was successful, the yield of cane the fourth year being 4,742 lbs. per acre. By rattooning the canes became harder each year.

Oats, sorghum, teosinte, and guinea grass gave profitable returns as fodder crops.

Cawnpore experimental farm (*Indian Agr., 21 (1896), No. 4, pp. 106-108*).—The farm, consisting of 51.33 acres, is situated about 3 miles southwest of Cawnpore city. It has special facilities for irrigation. The soil is a light reddish loam.

A fertilizer test with Mozuffernugger wheat was made on duplicate series of 13 plats, with bone dust, bone superphosphate, nitrate of potash, poudrette, gypsum, and cow and sheep manure. The last, alone or with gypsum, gave the largest yields.

Late planted maize produced a larger crop than early planted.

With cotton planted May 27 and June 20 the results favored the early planting.

HORTICULTURE.

Irrigation of garden crops, B. D. HALSTED and J. A. KELSEY (*New Jersey Stas. Bul. 115, pp. 16, pls. 4, figs. 2*).—This recounts the results of a series of irrigation experiments conducted on various garden crops which had been planted for the purpose of testing certain fungicides. The plats were each 11 by 33 ft., or one one-hundred-and-twentieth of an acre in extent. The irrigation was not begun until demanded by drought in the fall, and was continued from September 17 until the crops were harvested, varying with the different crops from October 4 to 28. The water used was from the city waterworks, and applied by means of inch faucets and hose, each averaging 3 gal. per minute, the water being distributed in channels between the rows.

The following table gives the amount of water used for each of the irrigated plats, amount per plant, and remarks as to the results:

Amount of water per plant and per plat and results.

Crop.	Total.	Average per plant.	Results.
	Gallons.	*Gallons.*	
Beans	1,685	5	164 per cent increase.
Peppers	1,830	22	83 per cent increase.
Eggplants	1,267	32½	Too late.
Tomatoes	1,550	64½	Do.
Turnips	2,705	9	Crop ruined by club root.
Celery	8,513	13½	142 per cent increase.
Total	17,550		

The cost of water supplied was $2.34. In the case of eggplants and tomatoes the season was so far advanced that no substantial results were noticed. New growth was stimulated in the eggplants but no increased fruitfulness was obtained. A plat of eggplants that was not irrigated had been mulched in July and treated with Bordeaux mixture. When compared with other unirrigated plants, some of which had been sprayed with Bordeaux mixture, while others had received no treatment, the mulched plat gave a yield nearly double that from the plat only sprayed with Bordeaux mixture, which in turn gave twice as many sound fruits as where no treatment was used.

With tomatoes a new growth was produced and the foliage was freshened but no gain in fruit resulted. With these and with eggplants irrigation must be given in midsummer instead of in late autumn.

As shown by the table, the result of irrigating bush beans was very satisfactory, the yield from the irrigated plat being 45 lbs. of pods, while the average yield of 9 unirrigated plats was 17 lbs. 1 oz. The quality of the irrigated beans was also superior.

The period of fruitage with peppers was prolonged and the yield nearly doubled, the irrigated plat giving 147 lbs. against 80 lbs. from an unirrigated plat. In addition, the fruit from the watered plants was firm and plump and of fine color and quality, thus being of greater market value.

The leaf development of turnips was greatly increased by irrigation, but, although there was an increased growth of roots, they were destroyed by the club root, which raged with unusual virulence in the moistened soil.

The soil of the celery plat was not the most favorable, but the yield of the irrigated plat was 42 lbs., while the unirrigated plat gave only 17½ lbs. The market value of the crop produced from the irrigated plat was 8 times that produced without the aid of artificial watering. The loss from outside leaves and roots in preparing the plants for market was 28 per cent in the case of the irrigated plants against 40 per cent in the nonirrigated plants.

Cassava, O. CLUTE (*Florida Sta. Bul. 35, pp. 331–339, pls. 4.*)—This discusses the propagation, manuring, culture, and harvesting of cassava (*Manihot aipi*), and the value of the roots as food for man and animals.

The use of cassava for preparing tapioca, starch, and glucose is briefly mentioned, and the botanical relationships of cassava among the Euphorbiaceæ are discussed. An analysis of cassava root is taken from Bulletin 44 of the Division of Chemistry of this Department. The illustrations are from photographs showing cassava plants and roots.

Taro and tropical yam, O. CLUTE (*Florida Sta. Bul. 35, pp. 346–348*).—This gives brief notes on taro (*Colocasia antiquorum*) and the tropical yam (*Dioscorea* sp.) now being grown on the station grounds. Both plants produce roots of considerable size and of agreeable flavor, although they are not thought to be as desirable as potatoes or sweet potatoes.

The pole Lima beans, L. H. BAILEY (*New York Cornell Sta. Bul. 115, pp. 293–314, figs. 17*).—This bulletin comprises descriptive, comparative, and cultural notes on Lima beans (*Phaseolus lunatus*) as grown at the station. All the 3 types of Lima beans—sieva, flat, and potato Limas—were grown. Three varieties of the sieva type, 9 of the large flat Limas, and 2 of the potato variety are noted.

The sievas are valuable chiefly because of their earliness, since the beans are neither as large nor as rich as those of the large Limas. The Willow Leaf variety is interesting on account of its peculiar foliage. Of the large flat Limas the variety Kaighn proved best, although Jersey and May Champion were also satisfactory. Of the potato Limas Dreer Improved produced a good yield of beans of high quality.

Four other varieties of Lima beans catalogued by dealers, but not grown at the station, are mentioned, and in addition descriptive notes are given of the Horticultural Lima and Chickasaw Lima or Jack bean. The Horticultural Lima is not a Lima bean at all, but merely a large fruited variety of the common garden pole bean (*Phaseolus vulgaris*). The Chickasaw Lima (*Canavalia ensiformis*) is a tropical species, which has been introduced in the Southern States, but it is believed will not mature in the latitude of New York. It produces long, hard pods bearing large white beans with prominent brown seed scars. The beans have been used for feeding to cattle, but are of little value for this purpose.

In the culture of Lima beans light, "quick" soils, especially those which are sandy and loose, but well manured, are best. Use should be made of concentrated fertilizers rich in potash and phosphoric acid and containing but little nitrogen. As the young plants are checked by inclement weather, the seeds should not be planted until the weather is thoroughly settled. Planting 7 or 8 beans to a hill 3 ft. apart in 4-foot rows is advised. After the plants are well up all but 3 or 4 are pulled out from each hill and the hills set with poles 6 ft. high. A yield of about 150 bu. of pods per acre is considered a good one. The most desirable varieties as regards productiveness and quality are the Jersey, Extra Early, Kaighn, May Champion, Dreer Improved, and Speckled Lima. Varieties of the potato Lima type are considered the richest.

Notes on the practice of growing Lima beans for seed in California are quoted from an article in the American Florist (E. S. R., 7, p. 504).

Notes on apricots at Phœnix Station, W. S. DEVOL (*Arizona Sta. Bul. 16, pp. 79–92*).—This consists chiefly of descriptive notes on 23 varieties of apricots belonging to the species *Prunus armeniaca*. The soil requirements of the apricot are discussed, it being stated that potash and phosphoric acid are the chief ingredients taken from the soil. In 9 varieties grown the pit averaged 6.2 per cent of the total weight of the fruit. The smallest pit was from the Kaisha, averaging 5.2 per cent of the weight, and the largest from Breda, composing 8.1 per cent of the total weight. The mean weight of fruits of all varieties was 1 oz., Breda being the smallest found, 22 to the pound, while the largest, 12 to the pound, were borne by Kaisha and Moorpark. Several of the varieties are grown upon both apricot and myrobolan stocks. In some of them no difference has been noticed, while in others the apricot stock gives larger, earlier, and better fruit than the myrobolan. Pringle was the earliest, St. Ambroise the finest appearing, and Royal the most prolific variety.

Present condition and treatment of orange groves, M. S. MOREMEN (*Florida Sta. Bul. 33, pp. 205–236*).—This bulletin discusses the condition in January, 1896, of the orange groves in the frost-stricken region of Florida. The trees were almost without exception killed to

the ground in December, 1894, or February, 1895, although groves on the shores of large bodies of water showed the influence of water protection by not being killed back to so great an extent as elsewhere. In the St. Johns River region the tops of the trees were injured, but the trees are not entirely dead. The frost-bitten trees are promptly sending out sprouts and shoots, and for renewing the orchards is recommended permitting several of these sprouts to grow up and form a head. Instead of following this method, budding may be practiced, either inserting buds about the old stump or setting them in the sprouts. The seedling trees are hardier, and it is thought will produce more vigorous sprouts. In addition, cultivation and liberal applications of fertilizers are insisted upon, perhaps supplemented by mulching.

Directions are given for grafting oranges, taken from information furnished by a prominent grower in the State. For the benefit of growers renewing their orchards or setting out new ones the following varieties are recommended: For autumn shipping—Centennial, Parson Brown, Boone Early, Nonpareil, Homosassa, Tangerine, Mandarin, and Satsuma; for midseason—Jaffa, St. Michael, Maltese Blood, Majorca, and in rich hammock lands Pineapple; for late—Hart Tardiff, King, and Valencia Late.

The question of restoring groves is discussed and definitely settled in the affirmative. The greater and lesser freezes in Florida for the past century are briefly discussed, and a record of the temperature of the freezes of 1886, 1894, and 1895 at different points in the State is given, taken from a paper by G. R. Fairbanks, read before the Florida State Horticultural Society.

Small fruits by irrigation, S. C. MASON and F. C. SEARS (*Kansas Sta. Bul. 55, pp. 127–148, plates 7*).—The first part of this bulletin consists of a discussion of the best methods of irrigation in Kansas and illustrated directions for the preparation of an irrigation "tank" or "pond" from which fields can be supplied with water at need. For small areas of ground of not over one acre in extent a wooden tank is considered satisfactory and economical, while for larger fields other methods must be adopted. Directions and illustrations are given for the construction of a reservoir 60 by 60 ft., inclosed by an embankment 6 ft. high, and of an outlet box and valve for regulating the flow of water.

The second part of the bulletin is occupied with a popular treatise on strawberry culture, with directions for setting, cultivation, and general treatment, and for picking and packing the berries. A tabulated list is given of 20 varieties which have proved best at the station for the last two years, showing the time of ripening and the relative productiveness.

The 1895 chrysanthemums, L. H. BAILEY, W. MILLER, and C. E. HUNN (*New York Cornell Sta. Bul. 112, pp. 213–244, pl. 1, figs. 12*).—This bulletin contains general remarks upon the subject of chrysanthemums, with notes upon the varieties grown at the Cornell Experiment

Station. The culture of chrysanthemums is briefly outlined, cuttings made from the tips of basal or strong lateral shoots in early spring being preferred, taken early or late as desired for field or pot culture, respectively. The growing of the plants to a single bloom gives large specimen flowers, but does not produce the most decorative results. Reform in the matters of nomenclature, synonymy, and classification is strongly urged, and suggestions in this respect are made.

The different forms of florets are described and 16 different styles are illustrated. Suggestions are made for breeding chrysanthemums for the production of new varieties, and recommendations are made for careful combination of the parent varieties to obtain artistically colored offspring. It is believed that fragrant varieties can be obtained in time. Already several varieties with a pleasant odor are extant. It is thought, however, that the fragrance can not be obtained in a large flowered variety. Descriptive notes, in several instances illustrated, are given for 90 varieties of chrysanthemums tested at the station, followed by a list of varieties considered most choice as regards size, single and combined coloring, season, oddity of form, and other characteristics. The following varieties of 1895 introduction are the choice of the authors: Mrs. Henry Robinson, Mrs. W. H. Rand, Crimsona, Iora, Madame Carnot, Miss Georgiana Pitcher.

Sweet peas, L. H. BAILEY and A. P. WYMAN (*New York Cornell Sta. Bul. 111, pp. 169–208, figs. 14*).—This bulletin gives a general sketch of the history of the sweet pea, with brief cultural directions, discussion of the various types of flowers, and a descriptive list of 106 varieties, giving the blooming season.

The author states that the sweet pea (*Lathyrus odoratus*) is a native of Italy and was introduced into England about 1700. Up to the first of this century only about 2 varieties were known in cultivation. Two closely allied species, the Tangier scarlet pea (*L. tingitanus*) and the perennial or everlasting pea (*L. latifolius*), are described and figured and recommended for cultivation.

It is advised that sweet peas be planted in the bottom of 4 to 6 in. furrows in rich, well-drained soil and the seed covered with about an inch of earth. As the plants grow the earth is to be gradually filled in until the furrow is full. The surface of the soil should be frequently cultivated until the peas begin to bloom, when a heavy straw mulch may be applied, to conserve moisture, as a large supply of water is essential for the best production of blooms. Training on about 5 horizontal wires on a trellis 3 or 4 ft. high is recommended.

The structure of the flower, comprising the standard, wings, and keel, is described and figured, and the tendency of these portions to become duplicated under a high degree of cultivation and careful selection is noted. The advancement in the number and perfection of varieties of sweet peas is chiefly due to the work of Eckford, an English gardener. The difference in varieties consists in both different forms

and colors, although the variations in tints are the most apparent at first glance.

It is urged that sweet peas are not plants for formal flower beds, but on account of their modest daintiness should be planted in half secluded places. The cultural methods employed with the varieties grown at the Cornell Station are briefly outlined. Notes, in several instances illustrated, are given of the varieties, and the following are considered as best: Adonis, Apple Blossom, Blanche Ferry, Boreatton, Butterfly, Captain of the Blues, Cardinal Wolseley, Countess of Radnor, Duchess of Marlboro, Emily Henderson, Empress of India, Improved Painted Lady, Isa Eckford, Lemon Queen, Mrs. Gladstone, and Tangier Scarlet.

Zinc in evaporated apples, H. W. WILEY (*U. S. Dept. Agr., Division of Chemistry Bul. 48, pp. 38*).—The investigations reported in this bulletin were undertaken to ascertain the correctness of the complaints made in Germany that American dried apples contain zinc salts in quantity sufficient to prove deleterious to health. The investigations and analyses heretofore made are briefly reviewed and the process of evaporating apples as commonly followed in the United States is detailed. The apples after the removal of the skin and core are frequently "sulphured" by exposing them to the fumes of burning sulphur for the purpose of preventing the freshly cut surface from turning brown owing to the oxidizing effect of the air. After the sulphuring process, which as a rule does not exceed half an hour, the apples are sliced and dried on trays with bottoms usually of galvanized iron wire screens. This method produces dried fruit of good taste and attractive appearance, but which has been recently reported in Germany as containing zinc, the metal undoubtedly having been taken up from the galvanized wire upon which the apples were dried.

Reports from the United States consuls at Hamburg, Cologne, and Frankfort-on-the-Main are quoted, giving an account of the restrictions against American dried apples in Germany because of their supposedly poisonous nature.

Samples of evaporated apples were obtained from various factories and dealers in New York State and analyzed in the Division of Chemistry. The methods of analysis recommended by several German chemists are quoted and the methods employed in the analyses here given are technically detailed. Twenty-three samples of evaporated apples were analyzed. In 5 of them no estimable quantities of zinc were found, while in the others the percentage ranged from 0.0016 to 0.0348. The average was 0.0152 per cent. The zinc was estimated as zinc oxid. Brief notes are given on each of the samples and their origin described. Some of the slices of evaporated apples were taken directly from contact with the galvanized iron wire, while others had not touched the wire at all. The iron wire used in making the drying trays was examined and found to lose its zinc covering in a few years from its being gradually dissolved by the acids of the apples.

The physiological action of zinc is briefly discussed. The salts are considered but slightly poisonous, and then only in large doses. The question of substituting other material for galvanized iron wire in the manufacture of trays has received attention, and the use of aluminum-wire netting or perforated sheets of aluminum is suggested. Trial evaporations with aluminum-bottomed trays have proved satisfactory.

It is not believed that evaporated apples contain sufficient zinc to produce the deleterious results feared in Germany, yet it is urged that to avoid further complaint the galvanized iron wire on which apples are now evaporated be replaced by some substance not readily acted upon by apple juices, or not poisonous if taken up by them.

Experiments with new orchard fruits, trees, and shrubs, J. L. BUDD (*Iowa Sta. Bul. 31, pp. 325–358, dgm. 1*).—This consists of brief descriptive notes on the native and foriegn varieties of orchard and small fruits and ornamental trees tested at the station. Notes are given on the fruit of 10 summer, 17 autumn, and 27 winter varieties of apples, 14 of pears, 25 of cherries, 11 of native and 12 of foreign plums, 4 of prunes, and 1 of apricots. Notes are given on the culture of the various fruits grown at the station, and, in addition, directions are included for the winter protection of peach trees by laying them flat upon the ground in late fall and covering them with straw and earth.

Spraying fruits; strawberries; grapes, J. T. STINSON (*Arkansas Sta. Bul. 39, pp. 17–34, figs. 2*).

Spraying fruits (pp. 17–22).—This article discusses the results obtained in spraying for apple scab, bitter rot, apple skin blotch (*Leptothyrum pomi*), some grape diseases, and strawberry leaf blight. The treatment was of advantage in all cases, and in several instances all injury was avoided. Bordeaux mixture was used. The causes of failure from spraying are discussed and are believed to be due to improper preparation of the mixtures, to lack of thoroughness in spraying, and to spraying in wet weather when the rains soon wash off the mixture.

The results are given of experiments in spraying apple trees in the orchard of one of the fruit growers of the State to prevent apple scab and apple skin blotch, the latter being wholly prevented by 3 applications of Bordeaux mixture. The yield from sprayed trees was over 3 times that obtained from the unsprayed check trees, and the apples averaged larger. In addition, the foliage was much more thrifty and remained on the trees later in the season.

Strawberries (pp. 22–25).—Notes on the strawberries grown at the station. From 100 varieties now being cultivated brief descriptive notes are given for 15 of the most desirable varieties. Reports are included on some of the leading varieties in various sections of the State.

Grapes (pp. 26–34).—This consists of a descriptive list of 81 varieties growing in the station vineyard, the botanical species from which each variety is derived being indicated.

Cost of growing onions (*Rural New Yorker, 1894, Dec. 1, p. 758*).

A Spanish truffle and 3 new species of truffles from Morocco, A. CHATIN (*Compt. Rend., 123 (1896), No. 4, pp. 211–214; Rev. Scient., ser. 4, 6 (1896), No. 5, p. 152*).

Small fruit culture for market, W. A. TAYLOR (*Amer. Gard., 17 (1896), Nos. 82, p. 457, figs. 9; 83, pp. 466, 467, fig. 1*).

List of varieties of fruits, W. S. DEVOL (*Arizona Sta. Bul. 15, pp. 59–76*).—This bulletin consists of lists of the varieties of different orchard and small fruits grown at the Tucson, Phœnix, and Mesa stations. The greater number of the varieties are old standard sorts, but mostly new in Arizona, and are tested to determine their value in this section. In addition, a number of new or little-known varieties, believed to possess qualities likely to recommend them for value in Arizona, are also included among those grown on the station grounds.

Report on fruits, S. T. MAYNARD and J. H. PUTNAM (*Massachusetts Hatch Sta. Bul. 37, pp. 1–29*).—This consists of cultural discussions and tabulated notes on the orchard and small fruits tested at the station, there being under consideration 148 varieties of apples, 64 of pears, 42 of peaches, 42 of plums, 145 of grapes, 20 of black raspberries, 20 of red raspberries, 16 of blackberries, 16 of gooseberries, 155 of strawberries, and 150 of seedling strawberries. The tables give data as to the blooming, ripening, yield, and quality of the various varieties, with brief notes on spraying for insect and fungus diseases which yielded to such treatment whenever remedies were found necessary.

Fruits at the Agricultural College, L. R. TAFT and H. P. GLADDEN (*Michigan Sta. Bul. 130, pp. 47–59*).—This consists of descriptive notes and tabulated data of 75 varieties of strawberries, 25 of black raspberries, 15 of red raspberries, and 17 of blackberries. The hardiness, yield, and general desirability of most of the varieties are remarked upon.

Fruits at South Haven, T. T. LYON (*Michigan Sta. Bul. 129, pp. 1–46*).—This bulletin consists of notes and tabulated data on the various varieties of orchard and small fruits tested at South Haven in 1895. Statistics of the dates of blossoming and ripening, yield, and quality are given for 156 varieties of strawberries, 53 of raspberries, 30 of blackberries, 3 of service berries, 24 of currants, 20 of gooseberries, 62 of cherries, 5 of mulberries, 191 of peaches, 1 of apricot, 1 of nectarine, 72 of plums, 37 of pears, 101 of apples, 8 of quinces, and several nuts, in addition to brief mention of asparagus and rhubarb. Owing to unfavorable season, fruiting of the grapes was interfered with and no notes are given. Brief mention is made of cultural methods and treatment, and of insect and fungus attacks, which, however, were not serious. Some experiments were made with several commercial fertilizers upon grapes, and the effect to date is tabulated.

Fruits and vegetables on the Gulf Coast, F. S. EARLE (*Mississippi Sta. Bul. 37, pp. 111–134*).—This recounts the result of extensive cultivation of various fruits and vegetables at the Ocean Springs Substation to ascertain their value in that latitude. The majority of fruits cultivated through the more northern parts of the United States were found not to thrive here, the best results being obtained from blackberries, grapes, figs, loquats, mulberries, pecans, persimmons, raspberries, and strawberries. Peaches, pears, and plums have been partially successful.

Flower bulbs and all of the common garden vegetables can be grown successfully. Of forage plants, redtop, carpet grass (*Paspalum platycaule*), water grass (*P. dilatatum*), and a few legumes have given the best results.

Some economic plants and their planting prospects, E. D. EWEN (*Jour. Trinidad Field Nat. Club, 2 (1895–'96), No. 12, pp. 294–305*).—Discusses the following species, recommending them for culture in the West Indies: Guarana (*Paullinia sorbilis* and *P. cupana*), star-anise seed tree (*Illicium anisatum*), nutmegs, clover, black pepper, gambiir (*Uncaria gambir*), rubber vines, indigo, and physic nut (*Jatropha curcas*).

Some New South Wales plants worth cultivating for shade, ornamental, and other purposes, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 6, p. 341*).

Extension work in horticulture, L. H. BAILEY (*New York Cornell Sta. Bul. 110, pp. 125-164*).—This bulletin consists of a report on the progress of the work undertaken by the Cornell University Agricultural Experiment Station in pursuance of the requirements of the experiment station extension law of the State. The researches and experiments in horticultural and entomological lines are briefly outlined, and the objects, methods, and results of extension of university teaching to the people of the State are given. Conspectuses of 5 so-called schools of horticulture held in different parts of the State are given, and in addition are included synopses of the lectures delivered at these schools, dealing with different phases of horticulture, botany, chemistry of the soil, insect and fungus diseases, etc. A list of the bulletins published under the auspices of the experiment station extension bill is appended.

FORESTRY.

The internal temperature of trees, C. FLAMMARION (*Bul. Min. Agr. France, 15* (*1896*), *No. 2, pp. 277–279, fig. 1*).—The author has made a study of the internal temperature of a number of trees and finds that it varies with the temperature of the air and is transmitted to the interior in proportion to the diameter of the tree and the condition of the wood whether living or dead. The minimum temperatures observed February 7 at 9 p. m. were for air —15.1°, dead poplar —14.9°, fir —11.8°, cherry —14.0°, dead cherry —14.2°, black locust undergrowth —12.3°, and black locust —10.2°. Figures are given for the internal temperatures of the same trees August 21, and it is shown that in the dead wood there was a wider diurnal range than in the living.

The effect of the diameter of the tree upon its temperature is shown by observations made during 8 days upon a large and a small black locust tree. The average temperature for 12 days was air 7.3°, small tree 9.4°, and large tree 10.1°. The average internal temperature of resin-bearing trees is said to be higher than those not producing it.

Mechanical and physical properties of Southern pine, B. E. FERNOW (*U. S. Dept. Agr., Division of Forestry Circular 12, pp. 12, dgms. 4*).—Notes are given on the mechanical and physical properties of the long-leaf pine (*Pinus palustris*), Cuban pine (*P. heterophylla*), short-leaved pine (*P. echinata*), and the loblolly or old field pine (*P. tæda*). The data given in the present circular are condensed from a special bulletin upon the same subject that is to be issued in the near future.

Familiar trees and their leaves, F. S. MATHEWS (*New York: D. Appleton & Co., 1896, pp. X, 320, figs. 215*).—This handsome work is an artist's description in popular language, illustrated in a rather satisfactory manner, of about 200 of the more common trees and larger shrubs of the region covered by Gray's and Chapman's manuals, with occasional references to some growing beyond these limits. The plan of the work is to afford a ready means for identifying trees by means of their foliage, other characters being called upon when necessary. The author seems to have been very successful in his undertaking, and the work will be found useful and instructive to the botanist as well as to those who are unfamiliar with botanical details. The nomenclature is that of Gray, with the names as given by Sargent as synonyms. A copious index is given of the scientific, common, and ordinal names of every species and variety described in the text.

The introduction to the work was written by Prof. L. H. Bailey, of Cornell University.

Forest-fire legislation in the United States (*U. S. Dept. Agr., Division of Forestry Circular 13, pp. 8*).—The Minnesota law, which is modeled after the New York and Maine laws upon the same subjects, is quoted, together with abstracts from the laws of Wisconsin, Maine, Colorado, New York, Pennsylvania, and New Hampshire. A summary in tabular form is given of the laws of all States and Territories having legislation upon the subject of forest fires. It appears from this table that all have some legislation upon this subject except the State of Washington.

Abies nobilis (*Gard. Chron., ser. 3, 20 (1896), No. 506, pp. 274, 275, pl. 1*).—Illustrated descriptive notes are given of this tree as grown in Ireland and elsewhere.

A contribution to the knowledge of North American Coniferæ, E. S. Bastin and H. Trimble (*Amer. Jour. Pharm., 68 (1896), No. 8, pp. 409–422, figs. 6*).—Notes are given on the histology and chemical composition of various species of spruce.

North American conifers in Germany (*Gard. Chron., ser. 3, 9 (1896), No. 503, pp. 187, 188*).

Eucalyptus in California (*Bul. Bot. Dept. Jamaica, n. ser., 3 (1896), No. 7, p. 149*).

Two good trees for California planting, H. G. Pratt (*Garden and Forest, 9 (1896), No. 444, p. 348*).—The author recommends *Robinia pseudacacia* and *Acacia melanoxylon* for planting in the region mentioned.

The spruce trees of eastern North America (*Garden and Forest, 9 (1896), No. 445, pp. 351, 352*).

The Burma teak forests, D. Brandis (*Garden and Forest, 9 (1896), Nos. 441, pp. 318, 319; 446, pp. 363, 364*).—Notes are given of the effect of a system of management upon the present condition of the forests, in which it is shown that the supply has been greatly increased by such means.

The wood pulp supply and our spruce forests (*Garden and Forest, 9 (1896), No. 446, pp. 363, 364*).—Notes are given on the rapid destruction of spruce forests and the necessity of some system of forest management is shown.

Investigations on the growth and condition of a 110-year-old pine forest, E. Omeis (*Inaug. Diss. Munich, 1895, pp. 34, pl. 1; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 2–3, pp. 200, 201*).

The trees of Paris, A. Chargueraud (*Les arbres de la ville de Paris. Paris: Rotschild, 1896, pp. XV, 333, figs. 333*).

DISEASES OF PLANTS.

Insect and fungus pests of potatoes, H. Garman (*Kentucky Sta. Bul. 61, pp. 14–35, figs. 7*).

Synopsis.—Notes are given on the occurrence and means for prevention of attacks of the Colorado potato beetle, Southern flea beetle, tobacco flea beetle, blister beetles, potato blight, and potato scab, due to various causes, and a report is given of experiments in checking scab in 1895.

The nature and amount of injury done by the Colorado potato beetle (*Doryphora decemlineata*), Southern flea beetle (*Epitrix fuscula*), tobacco flea beetle (*E. parvula*), and the margined blister beetle (*Epicauta cinerea*) is given and the use of arsenites is recommended for the destruction of the insects.

Brief notes are given on the potato blights due to *Phytophthora infestans* and *Macrosporium solani*, and the use of Bordeaux mixture is advised as a means for preventing these attacks.

An account is given of potato scab. Instances are cited of scab

being caused by attacks of wireworms, millepeds, and injuries caused by white grubs and small mammals, such as field mice, etc. The scab caused by *Oöspora scabies* is also figured and described. Plat experiments were conducted to test the value of Bordeaux mixture and corrosive-sublimate solutions for preventing scab. The injury done by the fungus on both treated and untreated plats was so slight as to give but little opportunity for comparison. The tubers were soaked in Bordeaux mixture and corrosive-sublimate solutions, and in one plat they were sprayed with Bordeaux mixture in the rows before covering. The use of Bordeaux mixture for soaking the seed seemed to have no beneficial action. The results with the corrosive-sublimate solution were sufficient to warrant the author recommending this treatment for scab prevention.

Potato scab, L. Foster (*Montana Sta. Bul. 9, pp. 22–24*).—Notes are given on experiments for the prevention of potato scab. A tabulated report is given of the results obtained by using zinc chlorid, zinc sulphate, potassium permanganate, potassium bicarbonate, potassium sulphid, and corrosive sublimate in different strengths of solution and for different lengths of treatment. The different compounds in some strength were somewhat effective in reducing scab, but the corrosive-sublimate treatment, when the seed tubers had been treated for at least an hour, proved the most successful treatment.

Diseases of the potato, E. G. Lodeman (*New York Cornell Sta. Bul. 113, pp. 249–283, pl. 1, figs. 3*).—Popular notes are given on the late blight or rot, the early blight, and scab of potatoes, together with notes on the injurious insects affecting the potato, and recommendations for the prevention of the several injuries.

The potato rot, or late blight, which is due to *Phytophthora infestans*, is fully described, and it may be successfully prevented by spraying the vines with Bordeaux mixture. In giving the life history of this fungus the author mentions oöspores as a means for carrying it over the winter. W. G. Smith[1] claimed that these bodies have been observed, but De Barry and others do not accept his conclusions.

The early blight, which has been recognized but a few years as distinct from the late blight, is usually attributed to attacks of *Macrosporium solani*, but recent investigations show a number of causes at work to produce the condition called early blight. These causes may be the fungus, peculiar character of the season, injuries of flea beetles, or some disturbance in the physiological functions of the plant. Each of these or several of them acting together may produce the disease. The Macrosporium is not an active parasite, and entrance to the host must be secured through tissues weakened by some of the means suggested. The use of Bordeaux mixture for this disease has met with only partial success, proper fertilization and cultivation having increased the yield to a greater extent than spraying.

[1] Gard. Chron., 4 (1875), No. 81, p. 68.

Notes are given upon potato scab, which is commonly caused by *Oöspora scabies*, and the corrosive-sublimate treatment is recommended. The publications of several stations are drawn upon for information relative to the effect of acid and alkaline conditions of the soil upon the disease. Formulas for the fungicides used and the results of some experiments for the repression of the disease are given.

Notes are included on the potato beetle and flea beetles, with directions for their destruction. Arsenites have proved most efficient for the potato beetle, while Bordeaux mixture seems most promising for protection against flea beetles.

A report is given of a comparative trial of different forms of spraying apparatus for applying Bordeaux mixture to potato plants. It was found that power sprayers were generally the best, those depending upon gravity for the distribution of the fungicide not proving wholly satisfactory. For the application of dry insecticides the powder guns tested were very satisfactory.

Potato blights and fungicides, L. R. JONES (*Vermont Sta. Bul. 49, pp. 81–99, figs. 4*).—Notes are given on selection of seed tubers as a means for the prevention of late blight, tests of different forms of Bordeaux mixture, and various forms of potato blight.

In 1895 the late blight was about 2 weeks late in attacking potatoes. This was due, the author thinks, to the unusual freedom from rot of the crop of 1894, the one supplying the seed. It is thought that by selecting for seed only tubers from fields of early potatoes which have escaped late blight, attacks of late blight would be almost wholly prevented. Comparative trials of various kinds of Bordeaux mixture and of Bordeaux powders show that fresh liquid preparations of standard strength gave the best results. Directions are given for the best way to make Bordeaux mixture as shown by the author's experiments.

By the term blight is generally meant any injury resulting in the premature dying of foliage of the potato. The author recognizes at least 4 forms of blight, the successful treatment of which requires that the cause be definitely known. The late blight, or mildew, is caused by *Phytophthora infestans*, and may be prevented by planting sound seed and spraying the plants with 2 or 3 applications of Bordeaux mixture. The early blight, or leaf-spot disease, is due to attacks of *Macrosporium solani* upon plants that are more or less weakened from various causes. The measures suggested for preventing this form of blight are to increase the vigor of the plant by selection of varieties, better cultivation and fertilization of the soil, later planting, and spraying the plants with Bordeaux mixture. Arsenical poisoning by the improper use of Paris green produces a condition resembling the blight due to Macrosporium, and may be avoided by using smaller amounts of Paris green, or adding lime to the water if it is applied in this form. When applied dry, it may be diluted with plaster. Tip burn, which is caused by dry, hot weather, aided by other conditions unfavorable to the plant,

is often confused with the early blight. Increasing the vigor of the plant and irrigation wherever possible will prevent tip burn to a great degree.

On the primary cause of potato scab, E. Roze (*Compt. Rend., 122 (1896), No. 18, pp. 1012–1014*).—From studies made upon pot cultures in which sound tubers were exposed to scabby ones the author is led to believe that the primary cause of the scab is bacterial, and the organism is called *Micrococcus pellucidus*. It is nearly spherical, about 0.6 μ in diameter, and is said to be very active. It is thought to prepare the way for *Oöspora scabies* or other organisms which live for a time at least as saprophytes upon the tissues destroyed by the Micrococcus.

A new disease of almond trees, U. Brizi (*Ztschr. Pflanzenkrank., 6 (1896), No. 2, pp. 65–72, pl. 1*).—The author describes an anthracnose of almonds which has appeared in Sardinia, the first specimens having been received from Cagliari in April, 1895. The disease is said to be caused by a new species of Glœosporium, to which the name *G. amygdalinum* has been given. The fungus is fully described, and numerous notes are given relating to its biology.

The fungus is said to attack the young fruit, although it rarely occurs upon the branches. The early indication of its presence is the appearance upon the green fruits of yellowish spots surrounded by concentric rings of lighter color. Later it appears as a gray rot. From the action of copper solutions upon the spores the author thinks that Bordeaux mixture will probably prove efficient in combating the disease.

Frost injuries to apples and pears, L. R. Jones (*Vermont Sta. Bul. 49, p. 100, fig. 1*).—Notes are given of a serious russeting of apples and pears, due to a late frost in 1895. The cause was attributed by many growers to injury from spraying, but investigation showed that sprayed and unsprayed trees suffered alike. The author reports having observed the same injury upon fruit in Canada, New York, and Wisconsin.

On the browning of grape cuttings, P. Viala and L. Ravaz (*Compt. Rend., 122 (1896), No. 20, pp. 1142–1144*).—The common browning of grape cuttings, which is due to bacteria and has been considered as a disease, is said by the authors to be without any pathological effect. Externally the cuttings retain their normal color and when grafted readily unite with the stock. They root well and produce vigorous branches. The bacteria are never found in the new growth no matter how abundant they may have been in the cutting, nor do they descend into the stock in case of grafting.

Experiments for the prevention of plum leaf spot and cherry leaf spot and fruit rot, S. A. Beach (*New York State Sta. Bul. 98, n. ser., pp. 17, pls. 5, fig. 1*).—Experiments were conducted during 1895 to determine the relative values of an eau céleste soap mixture and Bordeaux mixture for preventing leaf spot of plums (*Cylindrosporium padi*). While investigating the merits of the two fungicides the times

of application were also considered. A block of 567 trees was placed at the command of the author for the experiments. The varieties were Italian Prune, Guii, Lombard, Purple Egg, and Bavay Green Gage, one-third of each being sprayed with each fungicide and the other third being left as a check. The results obtained were carefully estimated and tabulated and the superiority of Bordeaux mixture was shown. The best results were obtained by 3 sprayings with Bordeaux mixture, the first applied just after the fall of the blossoms, the second about 2 weeks later, and the last about the middle of June. The trees given this treatment lost their foliage to the extent of about 10 per cent as compared with 73 per cent for the eau céleste and 78 for the check.

The good effect of the use of Bordeaux mixture in checking the ravages of black knot and ripe rot is commented upon, but such treatment must be supplemented by pruning out the knots and destroying all mummy fruits.

For the leaf spot and fruit rot of bearing cherry trees the results were not so satisfactory. The fruit rot was checked, but the foliage was injured by the treatment. The investigations upon the treatment of cherry trees are to be continued, and for the present no recommendations are made.

Spraying orchards and vineyards, J. C. WHITTEN (*Missouri Sta. Bul. 31, pp. 21*).—Spraying experiments that have been conducted for 2 years indicate that apple scab can be prevented by the use of Bordeaux mixture. Four applications were found more efficacious than three. In orchards sprayed in 1894 there was less scab than in the unsprayed ones. Bitter rot, while more destructive than usual, was less prevalent on trees sprayed with a 6-pound solution of Bordeaux mixture. Attacks of codling moth were not prevented by the use of arsenites, the injury being due, the author thinks, to a second brood of the moth appearing after the use of arsenites had been discontinued. Bordeaux mixture was efficient in causing less loss from plum rot where the trees were sprayed weekly throughout the ripening period. At this time ammoniacal copper carbonate solution is recommended, as it does not leave a sediment that injures the appearance of the fruit. Paris green was used with success for repressing the curculio.

Notes are given on the use of Paris green for destroying the bagworm on evergreen trees. If used as soon as the eggs are hatched, at the rate of 1 lb. to 300 gal. of water, the bagworm will be destroyed without injury to the trees. If the worms are two-thirds grown, double the strength of the insecticide will not kill the worms. Strong solutions of arsenites can not be used on evergreens until the wood is ripe and the weather dry.

A spraying calendar is added to the bulletin.

Directions for the use of fungicides and insecticides for the season of 1896, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. 37, pp. 30–40, fig. 1*).—Formulas and directions are given for the prepara-

tion and use of some of the more common fungicides and insecticides, as well as notes on some forms of spraying apparatus. Analyses are given of what is called "New Process" Paris green, which is shown to be not Paris green, but a mixture of lime, arsenious acid, and copper oxid. The substance varies in its constitution, the limits being arsenious acid 58 to 63 per cent, lime 14 to 16 per cent, and copper oxid 3 to 4 per cent. The use of this substance is not to be advised without a careful trial, as it is reported as injurious to many plants.

A spraying calendar for the year is given.

The rots of sugar beets (*Fühling's landw. Ztg., 45 (1896), No. 15, p. 481*).

On combating the heart and dry rots of beets, FRANK (*Deut. landw. Presse, 23 (1896), No. 64, pp. 568, 569*).

A new melon disease, M. C. COOKE (*Gard. Chron., ser. 3, 20 (1896), No. 506, pp. 271, 272*).—A new fungus disease is reported on leaves of melons, and it is thought possibly to be due to *Cercospora citrullina*, or, may be, to a new species.

The rotting of turnips and Swedes, M. C. POTTER (*Jour. [British] Board. Agr., 1896, No. 2, pp. 120–131, pls. 4*).—Notes are given of attacks of Botrytis on stored turnips and Swedes.

An American potato disease in Europe, C. SAJO (*Fühling's landw. Ztg., 45 (1896), No. 15, pp. 488–491*).

American blight (*Gard. Chron., ser. 3, 20 (1896), No. 506, p. 276*).—Hydrochloric acid mixed with clay or cow dung and applied with a paint brush is said to be a specific against blight of fruit trees. Care must be used in applying the mixture on account of the well-known corrosive action of the acid on plants.

A new smut on Panicum crus-galli, P. MAGNUS (*Ber. deut. bot. Ges., 14 (1896), No. 6, pp. 216–221, pl. 1*).—*Cintractia seymouriana* is figured and described from material communicated from North America.

The brown rust of peaches and its treatment, J. TACHAIRES (*Prog. Agr. et Vit., 26 (1896), No. 31, pp. 132–134*).—Descriptions of the disease are given, and 3 formulas of solutions of copper and iron sulphates are recommended as treatments.

Contagiousness and prophylaxis of the tubercle disease of the vine, F. LATASE (*Compt. Rend., 123 (1896), No. 3, pp. 200–202; Rev. Scient., ser. 4, 6 (1896), No. 5, p. 152*).

On the inefficacy of copper salts for controlling black rot, L. DEGRULLY (*Prog. Agr. et Vit., 26 (1896), No. 32, p. 143*).

Treatment of black rot, J. PERRAUD (*Le traitement du black rot dans les vignobles du centre et de l'est. Macon and Villefranche: 1896, pp. 64*).

Observations on the prevention of black rot of grapes, A. DE L'ÉCLUSE (*Études et observations sur le traitement intégral de la vigne contre le black rot, etc. Agen: Quillot, 1896, pp. XVI, 80*).

A report on field experiments for the prevention of black rot, G. COUDERC (*Prog. Agr. et Vit., 26 (1896), No. 35, pp. 232–239*).

Means for combating grape mildew, L. ANDERLIND (*Allg. Weinztg., 1896, p. 649*).

On the treatment of mildew by dilute solutions of copper sulphate, E. PERRIER DE LA BATHIE (*Prog. Agr. et Vit., 26 (1896), No. 30, pp. 103, 104*).—Notes are given on the successful employment of very dilute solutions of copper sulphate in preventing grape mildew.

Oïdium, anthracnose, and mildew, G. BATTANCHON (*Prog. Agr. et Vit., 26 (1896), No. 32, pp. 147–149*).

On the application of sulphur during the flowering period, H. DEVAUX (*Prog. Agr. et Vit., 26 (1896), No. 32, pp. 158–161, figs. 3*).—The author claims that applications of sulphur during the flowering period of grapes have no injurious effect.

Rassiguier's treatment for chlorosis of grapevines, A. MENUDIER (*Jour. Agr. Prat., 60 (1886), II, No. 31, pp. 157, 158*).

Concerning the principal diseases and enemies of the vine, J. PERRAUD (*Prog. Agr. et Vit., 26 (1896), Nos. 27, pp. 11-16; 28, pp. 48-50; 30, pp. 105-107; 31, pp. 123-132; 34, pp. 207-212, figs. 50*).—Illustrated descriptive notes are given of the principal insect and fungus enemies of the grape, with suggestions for their prevention.

Concerning the nature, appearance, and method of entering the host of the pine rust, J. ERIKSSON (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 12, pp. 377-394*).

A poplar disease in western France, P. DANGEARD (*Le Botaniste, 5 (1896), pp. 38-43*).—A preliminary note is given on a disease of poplar trees.

The bacterial diseases of plants, E. F. SMITH (*Amer. Nat., 30 (1896), Nos. 356, pp. 626-643; 357, pp. 716-731; 358, pp. 796-804*).—A critical review is given of the present state of our knowledge relating to bacterial diseases of plants.

ENTOMOLOGY.

The Mexican cotton boll weevil, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circular 14, 2d ser., pp. 8, figs. 5*).—This circular is a revision of Circular 6 (E. S. R., 7, p. 312) giving the results of supplementary investigation of *Anthonomus grandis*. The general appearance, life history, and habits are reviewed, and a map is given showing the localities at which the insect occurred in Texas in 1895. As a remedy trapping the weevils in the spring by planting a few early cotton plants which the weevils will attack before the bulk of the crop has developed bolls and in which they may be found and destroyed is suggested. As further treatment of the pest is suggested destroying the entire cotton crop in the infested region by burning it during the fall. This should be gradually done, so that weevils escaping at first may be destroyed later. In addition, clean cultivation is urged to prevent hiding places for the weevils.

The pear psylla and the New York plum scale, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 108, pp. 69-86, figs. 8*).—This bulletin consists of the matter contained in Bulletins 44 (E. S. R., 4, p. 472) and 83 (E. S. R., 6, p. 1004) of the station, with recently discovered facts concerning the life history and treatment of the insects.

The pear psylla (pp. 69-81).—The different stages and the life history of *Psylla pyricola* are described, and the pest is stated to have a distribution ranging from Maine to Virginia, and as far west as the Mississippi River. In the Northern States there are 4 annual broods, while in Maryland there are 5. Two predaceous insects have been found feeding upon the psyllas in great numbers, a lacewing fly (*Chrysopa oculata*) and the red ladybird (*Adalia bipunctata*). Spraying with kerosene emulsion is recommended as the most efficient treatment against both nymphs and adults, and successful experiments with this insecticide by a New York orchardist are quoted.

The New York plum scale (pp. 81-86).—The damage to New York orchards in 1894, as described in Bulletin 83, was greater than then supposed; but about 75 per cent of the scales were killed by the winter of 1894-'95. This decrease in the numbers of the scales, vigorous spraying with kerosene emulsion, and attacks on the scales by parasites

and ladybirds have made the ravages during 1895 small. Plum trees are most injured by the pest, although quince and apple trees are also attacked, and in one instance an ash grove was found to be infested. A hymenopterous parasite (*Coccophagus lecanii*) and the twice-stabbed ladybird have been active in attacking the scales. Spraying with kerosene emulsion is strongly urged, one application to be made after the leaves fall in the autumn and two others in the spring before the buds open.

Wireworms and the bud moth, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 107, pp. 37–66, figs. 26*).

Synopsis.—Illustrated descriptive and life-history notes on wireworms and the bud moth, with the results of experiments in combating them. Early fall plowing and the use of poisoned baits are recommended against wireworms, and spring spraying with arsenites against the bud moth.

Wireworms (pp. 37–56).—Wireworms and click beetles in general are briefly discussed, and the methods of experimentation with them described, the cages employed being kept under as natural conditions as possible, with untreated cages as checks. The possibility of protecting seed corn from the attacks of wireworms by coating it with various substances, and by soaking it in poisonous and disagreeable solutions, was tested extensively. Coatings of Paris green and flour and tar were applied, and the corn was soaked in solutions of salt, copperas, chlorid of lime and copperas, strychnin, kerosene, turpentine, and other substances without the least deterrent effect being produced. The wireworms readily ate the prepared seed, which in a number of cases had its germinating power injured by the processes to which it was subjected.

The destruction of the larvæ was attempted by means of starvation, and by various insecticides and fertilizers, without satisfactory results. The wireworms were found to live in fallow land, and where crops were grown on which they had been supposed not to feed, such as buckwheat, mustard, and rape. Kerosene, pure and as an emulsion, and carbon bisulphid killed the larvæ; but required use in such quantities that with the first substance the vegetation was destroyed, and with the second the expense would be too great for field use. Salt, potash salts, lime, gas lime, and chlorid of lime were either not effective or only in large quantities. The best results were obtained by plowing and harrowing for a few weeks in summer, commencing the latter part of July, by which procedure the earthen pupa cells were broken up and the tender, immature insects destroyed. In connection with this cultivation, short rotation of crops is advised. It was found that the adults could be readily attracted and killed by the use of trap baits of clover poisoned with some arsenite. Trapping by lanterns was of no practical value, owing to the small number captured.

Illustrated descriptive notes are given on the life history of the wheat wireworm (*Agriotes mancus*), *Asaphes decoloratus*, *Melanotus communis*,

Drasteria elegans, and *Cryptohypnus abbreviatus*. The first-named species constituted 91 per cent of the wireworms observed and experimented upon. The late larval, pupal, and early adult stages are best known, the habits of the adults as regards egg-laying and the early larval conditions being but scantily understood.

The bud moth (pp. 57–66).—Detailed notes on the life history, ravages, and treatment of *Tmetocera ocellana*, which is believed to have been imported from Europe about 1840, and is considered the most injurious insect and hardest to combat of any in the New York orchards. Its distribution, which now extends from New England to Idaho and from Canada to Maryland, is thought to be chiefly due to infested nursery stock, although the moths are active flyers as well. The different stages are described and the life history outlined. The half-grown brown caterpillars appear about the first of May, and pupation occurs in June. This is followed by a speedy emergence of the adults, which immediately lay the eggs singly or in clusters on the leaves. The ravages of the caterpillars are greatest in July and August. Then follows hibernation in silken cases, hidden in crevices of the bark, from September until the next spring. Only one annual brood has been observed.

Where nursery trees are attacked, hand picking of the caterpillar nests the latter part of May has proved effective. In the case of large trees frequent and thorough spraying with arsenicals is recommended, at least two applications to be made before the flowers open, so that on their emergence from winter quarters the caterpillars will find only poisoned food.

Insects injurious in 1895, O. LUGGER (*Minnesota Sta. Bul. 43, pp. 99–252, pls. 16, figs. 44*).

Synopsis.—This bulletin contains accounts of experiments with infectious diseases among chinch bugs, notes on migratory locusts, insects attacking potatoes, cabbages, currants, shade trees, and some other economic plants, and on the Hessian fly, plant lice, and scale insects.

The life history, and especially the hibernating habit, of chinch bugs is briefly discussed. The use of ditches, and of kerosene for spraying the insects and destroying them in the ditches both by contact and by burning, and the cleaning up of places where they might find harbor in winter are recommended as valuable methods for their destruction. The action of fungus diseases on insects and the method of making cultures for distribution among insect hordes are briefly outlined. The fungus found most useful at the station in combating chinch bugs in 1895 was *Isaria vexans*, obtained from the white grub at the Cornell Station. The fungus was propagated on an extensive scale in fruit jars in a mixture of corn meal and beef broth. The disease was found to be very effective in the infection boxes, and attacked insects other than chinch bugs in the laboratory without having been introduced upon them. The cultures were shaken up with water and sprayed upon wheat fields infested with chinch bugs. At first no effect was

noticed, probably owing to drought, but after a short time the disease appeared following showers, and killed practically all of the bugs. There were sent to 1,941 farmers in 46 counties of the State 14,877 boxes of infected chinch bugs. In addition other distributions of chinch bugs were made. A number of the distributions of fungus failed of the best effect on account of dry weather preventing the growth of the fungus, but in many cases the disease spread rapidly and checked the ravages of the bugs, though not always until after the rains had occurred.

A map is given showing the distribution of chinch bugs in the State in 1887, 1894, and 1895, as well as the location of pine and deciduous forest areas and prairies. Remarks are made on some fraudulent insecticides, particularly one containing equal parts of ginger and salt.

Notes are given on the fungus *Isaria tomicii*, found attacking bark beetles of the genus *Tomicus*, and bacterial diseases of the 2-striped locust (*Melanoplus bivittatus*), of a cabbage butterfly (*Pieris protodice*), and of the tent caterpillar. It was found impossible to introduce into the State the grasshopper disease, which was raging violently among grasshoppers in Colorado, but the cabbage-worm disease proved of easy propagation and killed all the caterpillars in the fields where it was introduced. The tent caterpillars disappeared before pure cultures made from the single diseased individual were ready for inoculation, but as with the other diseases attempts toward infecting will be made this year.

Notes are given on a grasshopper invasion of the State in the neighborhood of Duluth, where these insects in increasing numbers have been damaging vegetation for the past 2 or 3 years. Formerly the injurious grasshoppers were the Rocky Mountain locust (*Melanoplus spretus*), but the species concerned in this invasion were the lesser migratory locust (*M. atlanis*) and the pellucid locust (*Camnula pellucida*). Illustrated descriptions are given of these 2 species, and their life history is outlined. Early fall plowing of all the land in which eggs have been deposited is recommended as the best preventive method, and for a remedy against an invasion of adults the use of hopperdozers has been found most efficient. Hopperdozers were used over a space of from 36 to 40 square miles, where the grasshoppers were most abundant, with great success. Poisoned baits of bran mash and Paris green also killed large numbers. Illustrated notes are given on several parasitic enemies of grasshoppers, especially the red mite (*Trombidium locustarum*), tachina flies, flesh fly (*Sarcophaga carnaria*), bee fly (*Systœchus oreas*), and blister beetles (*Epicauta* spp.).

The history, life history, and remedial treatment for the potato beetle (*Doryphora decemlineata*) are given. There are 3 annual broods in Minnesota, of which the last hibernates in the adult state. Paris green, applied either dry or preferably mixed with water (1 lb. to 150 gal.) has proved the best and a most efficient remedy. Brief notes are also

given on the life history of some other potato insects, the blister beetles *Epicauta pennsylvanica* and *Macrobasis unicolor*.

Illustrated, descriptive, and life-history notes are given on the imported cabbage butterfly (*Pieris rapæ*), native cabbage butterfly (*P. protodice*), zebra caterpillar (*Mamestra picta*), cabbage plusia (*Plusia brassicæ*), and cabbage plutella (*Plutella cruciferarum*), and the destruction of the larvæ by the application of boiling water, pyrethrum powder or tea, or a mixture of lime and carbolic powder is recommended. As a rule, however, the attacks of parasitic hymenopters, especially *Apanteles glomeratus*, will effectually keep down the numbers of the pests.

Illustrated, descriptive, and life-history notes and remedial treatment are also given for sawflies in general, the imported currant worm (*Nematus ventricosus*), native currant worm (*Pristiphora grossulariæ*), currant plant louse (*Aphis ribis*), currant borer (*Sesia tipuliformis*), grapta butterfly (*Grapta comma*), and 4-lined leaf bug (*Pœcilocapsus lineatus*). Remarks are made on several borers that have proved injurious throughout the State, and descriptive, life-history, and remedial notes are given for the maple tree borer, red oak borer (*Trochilium luggeri*), ash tree borer (*T. fraxini*), and *Prionoxystus querciperda*. A leaf roller (*Cacœcia semiferana*) was injurious to box elder, and spraying with Paris green was found to assist the work of the natural parasites. The apple tree leaf roller (*Cacœcia rosaceana*), corn worm (*Heliothis armigera*), rosin weed caterpillar (*H. phlogophagus*), parsley butterfly (*Papilio asterias*), box elder bug (*Leptocorsia trivittata*), bean fly (*Anthomyia* sp.), wheat stem maggot (*Meromyza americana*), Hessian fly (*Cecidomyia destructor*), and several species of plant lice were variously injurious, and are described and remarked upon at length.

General remarks are made on scale insects, with descriptive and remedial notes on the mealy bug (*Dactylopius citri*), cottony maple scale (*Pulvinaria innumerabilis*), willow or cottonwood scale (*Chionaspis salicis*), cactus white scale (*Diaspis cacti*), elm tree white scale (*Chionaspis americana*), and eccentric scale (*Aspidiotus ancylus*).

Illustrated descriptions of various forms of apparatus for applying sprays, and directions for the preparation and use of insecticides, are given.

The habits of cutworms are briefly noted and the use of poisoned baits and insect lime against them is recommended. A list is given of 233 species of cutworm moths or owlet moths taken by sugaring at St. Anthony Park.

Some injurious insects, R. A. COOLEY (*Massachusetts Hatch Sta. Bul. 36, pp. 20, figs. 9*).—This comprises illustrated, descriptive, life-history, and remedial notes on the imported elm leaf beetle (*Galerucella luteola*), maple pseudococcus (*Pseudococcus aceris*), and Abbot sphinx (*Thyreus abbotii*).

The elm leaf beetle made its appearance in Massachusetts in the

summer of 1895 in the Connecticut Valley. The use of Paris green against the larvæ, kerosene emulsion against the pupæ, and arsenate of lead against the adults is considered the best treatment.

The maple pseudococcus has been found at several localities in the eastern part of Massachusetts and in the Connecticut Valley. A solution of whale oil soap applied with a brush or as a spray in late fall or early spring is believed to be effective treatment.

The Abbot sphinx is discussed on account of its having been frequently received at the station. It is not especially injurious, and it is believed that hand picking will be sufficient to keep down its numbers.

In addition, an article by C. H. Fernald, discussing the appearance and life history of the San José scale, with remedies, is reprinted from the Massachusetts Crop Report for August, 1895. Burning infested trees, if not too numerous, is regarded as the best remedy, although spraying with whale-oil soapsuds and resin wash is recommended.

Insect enemies of truck and garden crops, A. L. QUAINTANCE (*Florida Sta. Bul. 34, pp. 241–327, figs. 36*).—A popular bulletin briefly discussing the life history of insects in general, insecticides, and various forms of spraying apparatus, with special descriptive, life-history, and remedial notes on the chief species of insects affecting the bean, beet, cabbage, cauliflower, celery, squash, melon, eggplant, onion, and tomato. The encouraging of insectivorous birds is recommended. The tabulation of the insects treated in the bulletin is appended, indicating the proper treatment and the method of application. A list of materials used in making spraying solutions, with the cost of each, is given.

Methods of destroying chinch bugs, G. E. MORROW (*Oklahoma Sta. Bul. 19, pp. 8*).—A popular bulletin on the subject. The method of combating the pest by means of contagious fungus diseases is discussed, but more reliance is placed upon the barrier and trap method. In this method fields that it is desired to protect are surrounded with steep-sided ditches having holes in the bottoms 20 ft. apart, into which the bugs may fall and can be destroyed by kerosene or by crushing.

Monograph of the Bombycid moths of America north of Mexico, I, A. S. PACKARD (*Nat. Acad. Sci., 7 (1895), Memoir I*).—This treats of the family *Notodontidæ*.

Accelerated development of silkworm eggs, M. BELLATI and E. QUAJAT (*Arch. Ital. Biol., 25 (1896), No. 2*).—Notes on hastened maturity under various treatments.

Foul brood, or bee pest (*Jour. [British] Bd. Agr., 1896, No. 2, pp. 132–134*).—Notes are given on *Bacillus alvei*, with suggestions for combating its attacks.

Preliminary report on the tzetze fly disease in Zululand, D. BRUCE (*London: Bennett & Davis; reviewed in Nature, 53 (1896), No. 1381, pp. 566–568.*

Life history of the parasol ant, J. H. HART (*Trinidad Bul. Misc. Inf., 2 (1896), No. 7, pp. 166–177*).—Descriptions and notes on the habits of *Atta cephalotes* and *A. octospinosa*. Constant attention is necessary to destroy them, fire and sulphur fumes being used.

The San José scale, M. H. BECKWITH (*Delaware Sta. Bul. 30, pp. 16*).—This bulletin briefly notes the history of the San José scale, urging the necessity of united efforts against it, and gives the present status of the scale in Delaware and the extent to which other States are infested by the pest. The species has been found on fruit trees in 13 different localities of the State, pears, plums, and apples

being worst affected. The results of efforts with the different insecticides are mentioned. Spraying the trees with Bordeaux mixture and whale-oil soap and water, in addition to the winter resin wash and treatment with hydrocyanic acid gas, are recommended.

The San José scale in Missouri, J. M. STEDMAN (*Missouri Sta. Circular of Information 3, pp. 10, figs. 3*).—A brief popular account of the life history of *Aspidiotus perniciosus* and the best treatment, with a discussion of its distribution in the United States and its occurrence in Missouri. So far as is known, but one orchard in the State has been infested with the scale, and in that the diseased trees have been dug up and burned, so that it is hoped the spread of the pest is checked. Directions are given for preventing the entrance of the insect by careful inspection of imported nursery stock, and whale-oil soap wash is recommended for treatment.

A parasite of plants, Aspidiotus vastatrix or perniciosus (*Rev. Scient., ser. 4, 6 (1896), No. 4, pp. 124, 125*).

Combating Ocneria dispar in the United States, E. HENRY (*Ann. Sci. Agron., ser. 2, 1 (1896), pp. 276–290*).

The weevil Hypera murina as an injurious insect to alfalfa (*Deut. landw. Presse, 23 (1896), No. 71, pp. 630, 631, fig. 1*).

Revision of the Nematinæ of North America, C. L. MARLATT (*U. S. Dept. Agr., Division of Entomology Tech. Bul. 3, pp. 135, pl. 1, figs. 10*).—This bulletin is a technical monograph of this group, containing general notes on the geographical distribution, food plants, life history, and anatomy of these sawflies as a whole, with scientific descriptions and notes on 19 genera and 217 species occurring in America. Two genera and 90 species are described as new.

The grass and grain joint-worm flies and their allies, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Tech. Bul. 2, pp. 24, figs. 10*).—This bulletin comprises a technical discussion and synoptical keys for a number of American phytophagic Eurytominæ feeding in the stems of grasses and small grain and in the seed of grapes. The five genera Isosoma, Isosomorpha, Decatomidea, Eurytomocharis, and Evoxysoma, comprising 19 species, are included, 14 species being described as new.

Grain insects, P. LESNES (*Jour. Agr. Prat., 60 (1896), II, No. 32, pp. 197–202, figs. 27*).

Injurious insects and fungi (*Jour. [British] Bd. Agr., 1896, No. 2, pp. 153–166, figs. 4*).—Descriptions, life history, and suggested remedies for the prevention of the cherry moth, onion fly, *Carpocapsa pomonella* in walnuts, hop bug, surface caterpillars (*Agrotis* spp.), and a tomato disease due to *Cladosporium lycopersici*, are given. The tomato disease must not be confounded with *Macrosporium solani*. Spraying with Bordeaux mixture or a solution of copper sulphate is recommended as preventive treatment.

Notes on insect friends and foes, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 6, pp. 398–403*).

A list of the insectivorous birds of New South Wales, A. J. NORTH (*Agl. Gaz. N. S. Wales, 7 (1896), No. 6, pp. 380–397, pls. 10*).

Legislation and jurisprudence relating to insects useful and injurious to agriculture and insectivorous birds, G. VIRET (*Législation et jurisprudence concernant les insectes utiles et nuisibles à l'agriculture et les oiseaux insectivores. Paris: Berger-Levrault et Cie., 1896, pp. 265*).

Calcium carbid as an insecticide, E. CHUARD (*Jour. Agr. Prat., 60 (1896), I, No. 22, pp. 795–797*).

Composition of Paris green, C. A. GOESSMANN (*Massachusetts Hatch Sta. Bul. 38, pp. 11–13*).—Analyses of 8 samples of Paris green are reported. When 1 part of Paris green was treated with 100 parts of cold water the resulting solution contained about 3.5 per cent of arsenious acid. The hot water (80° C.) extract of 3 samples contained 15.67, 15.92, and 24.12 per cent, respectively. When the first solution was cooled, it showed only 3.39 per cent of arsenious acid.

Spray calendar, E. G. LODEMAN (*New York Cornell Sta. Bul. 114, folio, figs. 4*).—This spray calendar gives tabulated directions for spraying the most important fruits, vegetables, and flowers to prevent or remedy the attacks of various insects and fungus diseases. Formulas are given for the preparation of various insecticides and fungicides, and illustrations of several forms of spraying apparatus are appended.

FOODS—ANIMAL PRODUCTION.

The mineral constituents of muscular tissue, J. KATZ (*Pflüger's Arch. Physiol., 63 (1896), No. 1–2, pp. 1–85, figs. 3*).—The potassium, sodium, iron, calcium, magnesium, phosphorus from phosphates, phosphorus from lecithin, phosphorus from nuclein, chlorin, and sulphur were determined in human flesh, pork, beef, veal, and the flesh of goats, rabbits, dogs, cats, hens, haddock, eel, and pike. The results are expressed in graphic form. The maximum and minimum of each element is also given, calculated for fresh and water-free substances.

Relations between muscular work and the metabolism of the proteid materials of the body, A. CHAUVEAU (*Compt. Rend., 122 (1896), No. 8, pp. 429–435; abs. in Chem. Centbl., 4 (1896), No. 13, p. 718*).—Three experiments were made with a dog. In 2 of the experiments considerable muscular work was performed. It was found that practically the same amount of nitrogen was excreted in the urine whether work was performed or not. In the author's opinion these results confirm the conclusion drawn from previous experiments, that the combustion of carbohydrates in the muscles furnishes the energy for external muscular work. The following conclusions were also reached: The energy for muscular labor is furnished by oxidation processes, both complete and incomplete. When work is performed by a fasting animal, carbohydrates are replaced by a partial oxidation of fat. The energy necessary for muscular labor is never furnished by the oxidation of protein of the cells and tissues of the organism.

Investigation on the influence of muscular exertion on the metabolism of protein, O. KRUMMACHER (*Ztschr. Biol., 33 (1896), No. 1, pp. 108–138, pls. 2*).—In experiments with men the author finds that the nitrogen excretion in the urine is increased by muscular labor; the increase is, however, not regular nor proportionate to the amount of labor. In 1 experiment the amount of nitrogen metabolized could have furnished enough energy for the external work performed. In the 2 other experiments this was not the case. The conclusion is reached that fat and carbohydrates must also be considered sources of energy for muscular labor.

The influence of temperature on the amount of carbon dioxid and water vapor produced by man when performing severe muscular labor, H. WOLPERT (*Arch. Hyg., 26, No. 1, pp. 32–67, fig. 1, dgm. 1*).—These experiments were made with a respiration apparatus similar to that of Pettenkofer and Voit, described in Bulletin 21 of this Office (E. S. R., 7, p. 148). Some modifications and improvements in construc-

tion were introduced. The experiments were of several hours' duration and covered periods of rest, labor, and sleep. The author was himself the subject. His weight varied somewhat during the experiments, but the results in every case are recalculated to a uniform weight of 70 kg. The respiratory quotient was determined and the amount of water vapor produced. Very careful records of the temperature were kept and the amount of work performed was measured with an ergograph. Aliquot samples of the external air and of the respired air were taken for analysis by methods similar to those followed by Pettenkofer and Voit.

Some of the conclusions reached are as follows: A room temperature of between 5 and 25° exercised no particular influence upon the amount of carbon dioxid excreted during rest or when as much as 15,000 kilogrammeters of work per hour were performed. The amount of carbon dioxid produced in sleep, rest, and labor (15,000 kilogrammeters per hour) was in the proportion of 4:5:12. The amount of carbon dioxid produced per hour was increased about 50 gm. when 15,000 kilogrammeters of work were performed per hour. When the same amount of work was performed in an average temperature of 16°, 119 gm. of water vapor were produced; when no work was performed, the temperature being 22.5°, the amount of water vapor produced was 42 gm.; during sleep, the mean temperature being 20.1°, the amount of water vapor produced was 49.5 gm.

Some practical deductions from the results of these experiments are also made.

The excretion of carbon dioxid and water vapor by individuals of various trades during rest and work, H. WOLPERT (*Arch. Hyg., 26, No. 1, pp. 68–108, dgms. 9*).—Using the apparatus and following the methods referred to in the previous abstract (p. 149), experiments were made with shoemakers, seamstresses, a lithographer, a mechanic, and men of several other trades. Tables are given which show the amount of carbon dioxid and water vapor produced at rest and at labor. The amounts produced by the people of various trades are compared with each other and with the amounts produced by the author himself in the experiments reported in the previous article. Assuming that 1 kilogrammeter of work produced 3⅓ mg. of carbon dioxid, the author calculated the amount of work performed by the subjects. It ranged from 900 (seamstress) to 8,000 kilogrammeters (shoemaker), in every case falling below the 15,000 kilogrammeters performed by the author in the experiments of which he was the subject. The practical application of his results is briefly discussed.

Does muscular energy depend directly upon the energy of the protein of the food? A. CHAUVEAU and C. CONTEJEAN (*Compt. Rend., 122 (1896), No. 9, pp. 504–511, diag. 1*).—Two sets of experiments were made with a dog; in one the food consisted of meat and in the other of gelatin. In each experiment there were periods of rest and of

work. The conclusion is reached that, since the excretion of nitrogen in the urine is not increased by muscular exercise, the protein of the food is not directly concerned in the production of work. (See also p. 156.)

Respiration and muscular energy, A. CHAUVEAU (*Compt. Rend., 122 (1896), Nos. 2, pp. 58–64; 3, pp. 113–120*).—The author divides the energy expended when a muscle is doing positive work—for instance, lifting a weight—into two parts, one utilized in displacing the weight and the other in sustaining it during displacement. The external work of lifting a weight was measured directly, and the energy changes in the muscles indirectly by means of respiration experiments in which the respiratory quotient was determined. The experimental details are given. The conclusion is reached that the mechanical work done by muscles in lifting a weight requires only an equivalent expenditure of energy. (See also p. 156.)

Dietary study at Lyman School (*Sixteenth Annual Rpt. Trustees State Primary and Reform Schools (Massachusetts), 1895, pp. 25–27*).—A dietary study of one of the families at the Lyman School was made by Mr. Chapin and Mr. and Mrs. A. S. Meserve. The family consisted of 34 boys, 4 adult officers, and 2 children 4 and 8 years old. The ages of the boys ranged from 11 to 19 years. The duration of the experiment was 1 week. The composition of most of the articles of food consumed was calculated from standard tables. A few analyses were made at the laboratory of the Massachusetts State Board of Health. The nutrients consumed per individual per day were protein 0.265 lb., fat 0.183, carbohydrates 1.278, and the weight of the food was 4.25 lbs.

Leaves as a food for farm animals, F. H. WERENSKIOLD (*Tidskr. norske Landbr., 3 (1896), pp. 22–34*).—The author gives analyses of the leaves of elm, ash, aspen, birch, alder, mountain ash, yellow willow (*Salix caprea*), and gray willow gathered at Aas Agricultural College (Norway). The analyses cover a period of several years. In some instances the leaves, together with small twigs, were analyzed, and in other cases the leaves only. In addition to the usual determinations, in the later analyses indigestible albuminoids, digestible albuminoids, amids, tannin, gallic acid, and pentosans were determined.

The average digestion coëfficients obtained for the protein in the leaves were: Ash, 74.1 per cent; elm, 67.3; gray willow, 65.2; mountain ash, 62.2; aspen, 60.6; yellow willow, 56.9; alder, 52.7, and birch, 41.1. Including the earlier analyses, the average digestion coëfficients of the tannin-free leaves were as follows: Ash, 10.34 per cent; elm, 9.56; aspen, 7.68; mountain ash, 6.59. Neither starch nor alkaloids were found in any of the leaves analyzed.—F. W. WOLL.

Analyses of silage from stack silos, P. HELLSTRÖM (*Rpt. Ultuna Agl. Institute, 1894, pp. 75–77*).—Samples were taken from silo stacks built according to Ramstedt's method. The ages of the different samples, when sampled, were as follows: Sample I, 5 months; sample II, 13

months; sample III, 5 months; samples IV and V, 6 months. The results of analysis were as follows:

Analysis of silage from stack silos.

	As sampled.					Dry substance.				
	Grass with some clover.		Green rye.	Glyceria spectabilis.	Clover (mainly).	Grass with some clover.		Green rye.	Glyceria spectabilis.	Clover mainly).
	I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Water	63.75	75.55	82.52	80.64	62.78	....	....	....	....	....
Crude protein	4.72	3.03	1.58	1.52	7.21	13.03	12.41	9.04	7.84	19.37
Crude fat	1.59	1.25	.97	.42	1.37	4.40	5.12	5.58	2.18	3.37
Carbohydrates	15.53	11.78	} 13.39	15.59	24.98	{ 42.81	48.15	} 76.59	80.54	67.03
Crude cellulose	12.08	6.55				{ 33.32	26.81			
Ash	2.33	1.84	1.54	1.83	3.70	6.44	7.51	8.80	9.44	9.93
Nitrogen	.76	.48	.25	.24	1.15	2.08	1.97	1.45	1.25	3.10
Acidity	1.03	.98	.77	.88	1.09	....	....	....	....	....

—F. W. WOLL.

Feeding experiments with Rehnström's "horse bread," J. V. NORDENDAHL (*Tidskr. Vet. Med., 14 (1895), pp. 242–247*).—Several feeding trials were made with "horse bread" (E. S. R., 7, p. 247) on horses in different regiments of the Swedish army, with favorable results. One pound of the bread is said to possess about the same feeding value as 2 lbs. of oats. Analysis shows its composition to be as follows: Water, 8.16 per cent; ash, 3.45; protein, 17.13; carbohydrates, 66.50, and fat, 4.76.—F. W. WOLL.

Report of the State Chemical-Control Station of Norway for 1895, F. H. WERENSKIOLD (*Christiania: 1896, pp. 51*).—The report gives the usual résumé of the main work of the chemical-control station during the year. The following results are deemed of more general interest:

Analyses of Norwegian root crops.—The investigation was begun in 1893, the object being to study the average composition of the main Norwegian root crops and the variations to which they are subject. Forty-seven samples were analyzed during 1895. The average data obtained for the different kinds of crops are shown in the following table:

Average composition and yield of root crops, 1895.

	Number of samples.	Water.	Dry matter.	In dry matter.					Yield per acre.
				Ash.	Ether extract.	Protein.	Crude fiber.	Nitrogen-free extract.	
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Bushels.*
Carrots	8	88.54	11.46	6.42	2.50	5.34	7.11	78.73	574
Swedish turnips	7	87.93	12.07	5.87	3.62	7.23	8.63	74.65	758
Yellow turnips	25	91.38	8.62	7.93	3.38	9.32	10.32	69.05	1,102
White turnips	6	91.80	8.20	8.19	3.94	7.63	10.76	69.48	1,370
Fodder beets	1	83.80	16.20	5.92	1.21	5.48	3.18	84.21	344

Composition of goat manure.—A sample of goat manure was analyzed and found to contain: Nitrogen, 0.74 per cent (0.042 per cent in the form of ammonia); phosphoric acid, 0.24 per cent, and potash, 0.17 per cent, indicating a composition and value similar to sheep manure.

Alkaloids in distillery slump.—A sample of distillery slump was found to contain 6 decigrams solanin and 1.5 decigrams solanidin salts per liter of slump; also 0.4 volume per cent of alcohol, a small trace of copper, and an alkaloid substance, most likely a ptomaine. An animal consuming 30 liters of slump per day would thus take in 18 gm. of solanin and 4.5 gm. solanidin salts daily.—F. W. WOLL.

Report of agricultural chemical work for the Royal Agricultural Society (Norway) in 1895, V. STEIN (*Tidsskr. Landökon., 14 (1895), pp. 618–635*).—The author describes the chemical control work on feeding stuffs, fertilizers, and dairy products performed during 1895 for this society. Of the 503 samples of feeding stuffs analyzed there were 191 samples of rape-seed cake, 113 of wheat bran, 70 of sunflower-seed cake, 33 of cotton-seed meal, 28 of linseed cake, 6 of cocoa cake, and 6 of palm-nut cake. The 1,520 samples of fertilizers examined included 817 samples of superphosphates, 238 of mixed fertilizers, 152 of potash salts, 143 of Thomas phosphate, 41 of bone meal, and 42 of Chile saltpeter. The 3,867 samples of dairy products included 1,899 samples of milk, 1,920 of butter, and 46 of cheese.

All samples of feeding stuffs analyzed were examined microscopically to ascertain their purity. The following table gives the average composition of the common feeding stuffs analyzed in 1893–'94 which microscopic examination proved to be free from foreign impurities:

Average composition of pure concentrated feeding stuffs.

	Moisture.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Linseed cake	11.9	6.8	30.7	10.0	31.6	9.0
Rape-seed cake	10.3	7.4	33.9	11.5	28.0	8.9
Cotton-seed cake, decorticated	7.8	6.6	46.8	6.5	21.3	11.0
Peanut cake, decorticated	9.2	6.2	46.5	5.5	23.8	8.8
Sunflower-seed cake, I [1]	7.9	5.7	39.1	11.9	19.6	15.8
Sunflower-seed cake, II [1]	8.2	5.4	32.9	20.1	19.7	13.7
Hemp-seed cake	10.3	8.2	32.0	20.5	19.9	9.1
Palm-nut cake	10.0	3.7	17.0	26.0	34.8	8.5
Cocoa cake	9.0	5.9	21.0	16.0	34.3	13.8
Sesame cake	9.0	10.7	38.2	4.2	23.6	14.3
Wheat bran	12.1	5.6	16.5	10.0	52.0	3.8
Rye bran	10.8	4.5	16.6	5.6	59.4	3.1
Rice bran	10.0	7.2	11.6	12.0	49.2	10.0

[1] Sunflower-seed cake is divided into two groups according to the combined content of nitrogenous substances and fat, viz, I, 50 per cent and above, and II, below 50 per cent.

The number of samples included in this summary is not given in the original.—F. W. WOLL.

Report of Oerebro Chemical Station and Seed-Control Station for 1894, J. WIDEN (*Oerebro (Sweden): 1895, pp. 48*).—This contains the usual accounts of chemical and seed control work, including analyses

of fertilizers (p. 117), feeding stuffs, and dairy products (p. 174). The following average analyses of feeding stuffs are given:

Average analyses of feeding stuffs.

	No. of samples.	Moisture.	Ash.	Crude protein.	Carbohydrates.	Crude fat.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Rape-seed cake	23	9.44	8.01	34.64	38.81	8.99
		7.40–11.97	6.75–10.02	32.50–37.00	35.77–42.01	7.52–10.90
Peanut cake	32	9.23	6.19	46.99	28.96	8.29
		7.83–10.96	4.50–8.05	42.93–50.63	25.43–31.36	6.32–13.25
Wheat bran	12	11.82	5.03	15.98	[1] 9.50	3.48
		10.90–14.33	3.75–6.25	13.00–18.37	[1] 8.02–10.65	2.30–5.51
Rye bran	11	11.28	4.83	16.54	[2] 6.31	3.00
		9.77–12.42	3.93–5.47	11.87–18.00	[2] 5.40–7.20	1.78–3.49

[1] Crude fiber; nitrogen-free extract, 53.45 per cent (51.76–54.77).
[2] Crude fiber; nitrogen-free extract, 57.53 per cent (55.51–61.15).

—F. W. WOLL.

Dangers from rancid cotton cake, D. CRISPO (*Rap. Trav. Lab. Etat, Anvers, 1893, pp. 13, 14*).—The killing of 13 head of cattle by eating damaged cotton-seed meal is reported. The *post-mortem* examination indicated inflammation of the mucous membrane similar to gastro-enteritis. An examination of the meal showed the presence of a considerable amount of free acid, due to the action of a special butyric ferment. Milk inoculated with this ferment acquired in a few hours the same odor as that observed in the damaged meal. It is suggested that this ferment produces an abnormal acid digestion which results finally in inflammation of the stomach and death.

Calf-feeding experiments, G. J. LEUFVEN (*Rpt. Ultuna Agl. Inst., 1894, pp. 47, 48*).—Six calves, divided into 2 uniform lots, were fed sweet whole milk, and later skim milk with ground flaxseed and oatmeal. Lot 1 was fed from pails and lot 2 with patent calf feeders. The two lots were fed 3 times daily and received the same quantities of food. The experiment proper covered 9 weeks. One of the calves in lot 1 died from diarrhea; the 2 other calves in the lot gained 184.5 and 194.4 lbs., respectively. The calves in lot 2 gained 236.5 lbs., 179.9 lbs., and 210.5 lbs., respectively.

The author concludes that feeding calves with a good artificial feeder results in greater gains in weight than feeding from a pail, and that while it does not prevent the appearance of diarrhea it diminishes the number of cases.—F. W. WOLL.

Fattening experiments with sheep during 1895, J. GRUDE (*Landmandsvennen, 4 (1896), pp. 1–7*).—The experiments were conducted under the auspices of the Norwegian Government at 11 different farms in the county of Stavanger, on a plan similar to that followed in previous years (E. S. R., 5, p. 919). The experiments included 199 sheep divided into 11 lots, and lasted from 40 to 58 days. The average quantities of feeding stuffs fed daily were as follows: Hay, 1.1 lbs.; turnips, 9.4; linseed cake, 1.4, and oats, 0.7. The gains in weight made during

the experiment, the age, length of fattening period, the cost, and selling price of each sort of sheep are given in the following table:

Results of sheep-feeding experiments in 1895.

	Number of animals.	Age.	Length of fattening period.	Weight at beginning.	Gain made per head.	Purchase price per pound.	Selling price per pound.	Profit per head.
		Years.	*Days.*	*Pounds.*	*Pounds.*	*Cents.*	*Cents.*	
Wethers	137	$1\frac{1}{2}$–$3\frac{1}{2}$	47.9	109.9	26.1	4.5	5.5	$2.49
Young ewes	33	$1\frac{1}{2}$–$4\frac{1}{2}$	48.4	107.7	25.4	4.5	5.4	2.40
Ewes	22	$2\frac{1}{2}$–$9\frac{1}{2}$	45.7	109.1	23.9	4.3	5.4	2.46
Spayed ewes	6	$4\frac{1}{2}$–$7\frac{1}{2}$	52.0	107.3	22.7	4.5	5.5	2.36
Lambs	1	$\frac{1}{2}$	56.0	86.0	22.0	5.1	5.5	1.64
Average			47.9	109.3	25.8	4.5	5.5	2.46

As found in the previous series of experiments, the gains in live weight after the sixth week were smaller, and in some cases there was a decrease in weight. The quality of the carcass may, however, have improved during the period.—F. W. WOLL.

Food products of the world, MARY E. GREEN (*The Hotel World, Chicago, 1896, pp. XI, 249*).—The book contains description of many common and uncommon foods and condiments. The work is largely based on the exhibits of food at the World's Columbian Exposition.

Starch, its digestion and value as a nutrient, J. E. HOBART (*Diet. and Hyg. Gaz., 12 (1896), No. 9. pp. 543, 544*).—A brief review of the subject.

On the determination of gluten in flour, BALLAND (*Compt. Rend., 123 (1896), No. 2, pp. 136, 137*).—A note on the influence of different methods of milling on the gluten and nitrogen content of flour.

On the nutritive value of flours and on the economic consequences of excessive bolting, BALLAND (*Compt. Rend., 122 (1896), No. 25, pp. 1496–1498; Rev. Scient., ser. 4, 6 (1896), No. 2, p. 55*).—The author believes, on the ground of their chemical composition, that the coarse flours are better fitted to furnish nutrients in the correct proportion than the finer sorts.

On the nutritive value of bread from different specimens of screened flour, A. GIRARD (*Compt. Rend., 122 (1896), Nos. 23, pp. 1309–1313; 24, pp. 1382–1388*).—From a study of the amount of phosphorus in various kinds of bread the author concludes that there is no reason for the belief that bread from coarse flour is to be preferred to white bread if the digestive organs are healthy.

Rieti wheat, its suitability for bread making, J. GENIN (*Jour. Agr. Prat., 60 (1896), II, No. 36, pp. 355, 356*).—The author reports favorably on this variety of wheat.

A poison in cotton seed and cotton cake, C. CORNEVIN (*Ann. Agron., 22 (1896), No. 8, pp. 353–361*).—Pigs were killed by feeding Egyptian seed and cake to them. The cold water extract of the whole seed was injected into a dog and it died in 18 hours. The kernel contains more poison than the hull. The oil was found to be harmless.

The albuminoids and fats of agricultural foods, R. WARINGTON (*Agl. Students' Gaz., n. ser., 8 (1896), No. 1, pp. 4–11*).—A general discussion of the subject.

The preservation of foods and condiments, ANDÈS (*Das Konservirung des Nahrungs- und Genussmittels. Vienna, Pest, Leipzig: Hartleben.*

A few practical hints on the dieting of the native sick and invalids, DUTT (*Indian Med. Jour., 30 (1895); No. 11, pp. 437–441; and Diet. and Hyg. Gaz., 12 (1896), No. 2, pp. 73–81*).—The author urges the importance of a diet for the native sick suited to their dietary habits. A very large number of native foods and food preparations are described, and their use in disease and convalescence is discussed.

An outline of the diet of man in health and disease, H. SCHLESINGER and H. BECKER (*Grundzüge der Ernährung des gesunden und kranken Menschen. Frankfort: H. Bechhold, pp. 60*).—The authors give briefly the principles of diet, describe various foods and condiments, and suggest a number of menus which are very low priced.

How to feed children: A manual for mothers, nurses, and physicians, LOUISE M. HOGAN (*Philadelphia: J. B. Lippincott Co., pp. 236*).—The book is a practical discussion of the foods suited to infants and children, methods of preparing foods, and the diet suited to various conditions of health and disease.

Rules of diet for health and disease, J. BORNTRÄGER (*Diät-Vorschriften für Gesunde und Kranke jeder Art. Leipzig: H. Hartung und Sohn, 1896, 2d ed.*).

The relation, as shown by the respiratory quotient, between the expenditure of energy by a muscle and the shortening it undergoes, A. CHAUVEAU (*Compt. Rend., 123 (1896), No. 3, pp. 151–155; abs. in Rev. Scient., ser. 4, 6 (1896), No. 5, p. 152*).—For a given amount of external work done by the muscle the energy is smaller as the muscle is nearer its maximum length.

On the transformation of fat into carbohydrates in animals consuming no food, A. CHAUVEAU (*Compt. Rend., 122 (1896), No. 20, pp. 1098–1103*).—Hibernating animals sometimes increase in weight. In the author's opinion this may be accounted for by the partial oxidation of stearin of fatty tissue to glycose, carbon dioxid, and water. In this case the respiratory quotient should be constant and equal to about 0.78.

Source and nature of potential energy directly utilized in muscular work as shown by the respiratory quotient in fasting man, A. CHAUVEAU (*Compt. Rend., 122 (1896), No. 21, pp. 1163–1169; Rev. Scient., ser. 4, 5 (1896), No. 20, p. 726*).—The respiratory quotient increases rapidly when muscular work is commenced, but diminishes if the work is prolonged. After an hour's rest the respiratory quotient is normal. The following conclusions are reached:

(1) The evidence furnished by the respiratory quotient seems to indicate that fat is not used directly by the muscles in the production of energy even by a fasting man.

(2) The energy for muscular exertion is furnished by carbohydrates.

(3) Muscular exertion exhausts the reserve of glycogen and glycose when these reserve materials are stored up. There is a tendency to renew these materials as they are used in spite of fasting. The respiratory quotient indicates that this takes place at the expense of fats, which are thus indirectly the source of muscular energy.

The respiratory quotient of animals either fasting or fed a diet rich in carbohydrates when muscular contractions are produced by means of electricity: Deduction concerning the potential energy directly expended in internal muscular exertion, A. CHAUVEAU and F. LAULANIE (*Compt. Rend., 122 (1896), No. 22, pp. 1244–1250*).—Experiments were made with dogs and with rabbits which confirm the authors' previous conclusions (see above).

The utilization of fat in food from the evidence furnished by the respiratory quotient as to the potential energy used for muscular work by a man on a diet of fat, A. CHAUVEAU, TISSOT, and DE VARIGNY (*Compt. Rend., 122 (1896), No. 21, pp. 1169–1173; abs. in Rev. Scient., ser. 4, 5 (1896), No. 23, p. 727*).—Experiments are reported which in the authors' opinion show that fat is transformed into reserve material (carbohydrates) which serve as the source of muscular energy.

On the nature of the chemical processes involved in muscular action, A. CHAUVEAU (*Compt. Rend., 122 (1896), No. 23, pp. 1303–1309*).—The author cites many authorities and defends his position on the above question.

Practical results of experiments in metabolism conducted on the working horse, ZUNTZ (*Deut. landw. Presse, 23 (1896), Nos. 64, p. 571; 65, pp. 579, 580*).—In the form of a lecture the author discusses some of the results of experiments on the metabolism of work horses.

The influence of spaying on metabolism, CURATULO and TARULLI (*Centbl. Physiol., 9 (1896), p. 149; Ztschr. Fleisch- und Milchhyg., 6 (1896), No. 11, pp. 219, 220*).—Experiments were made with a female dog, the diet being the same before and after the operation. The daily excretion of phosphoric acid was determined, and the authors conclude that it was diminished by spaying.

Intestinal fermentation when the flesh of tuberculcus cattle is fed, KUTSCHER (*Arch. Hyg., 27, No. 1, pp. 34–40*).—The author fed the flesh of tuberculous and healthy cattle to dogs. The conclusion was reached that the flesh of tuberculous animals, both the diseased and normal tissue, was more susceptible to intestinal fermentation than that of healthy animals.

The action of mustard and pepper on pancreatic digestion, GOTTLIEB (*Jour. Pharm. et Chim., ser. 6, 3 (1896), No. 11, p. 552*).—In experiments with rabbits the secretion of pancreatic juice was tripled or quadrupled without materially diminishing its strength or digestive power for carbohydrates, fats, or albuminoids.

Bellow's "Origin of species by a change in environment" in stock breeding, L. ADAMETZ (*Jour. Landw., 44 (1896), No. 2, pp. 159–170*).

The importance of the mineral constituents of plants for the nourishment of cattle, TANCRÉ (*Fühling's landw. Ztg., 45 (1896), No. 12, pp. 375–382*).—A brief summary of the subject.

Influence of locality on cattle, R. BRUCE (*Agl. Jour. Cape Colony, 9 (1896), No. 10, pp. 250–252*).—Extracts from a paper on the above subject read before the London Farmers' Club.

The slaughter tests at the fat-stock show at Berlin in 1896, C. LEHMANN (*Deut. landw. Presse, 23 (1896), Nos. 46, pp. 406, 407; 47, p. 415*).—The article contains a large number of statistics.

Monograph on Illyrian cattle: The relation of this breed to other breeds, L. ADAMETZ (*Jour. Landw., 44 (1896), No. 2, pp. 105–136*).—The author believes that the Illyrian cattle are the direct descendants of the prehistoric Brachyeros of central Europe in the time of the lake dwellers.

Investigation on the anatomical structure of the Montenegrin branch of the Illyrian breed of cattle, L. ADAMETZ (*Jour. Landw., 44 (1896), No. 2, pp. 137–157*).—A description of the breed is given and a comparison of it with the Bosnia-Herzegovina breed.

Sheep breeding in the Deccan, J. W. A. MORGAN (*Agl. Ledger, 1895, No. 18, p. 3*).—Notes on the above subject, mentioning several breeds.

French mutton sheep of the Charmoise breed, R. BEHMER (*Deut. landw. Presse, 23 (1896), No. 67, pp. 595, 596, figs. 5*).

The production of wool and the dairy industry in the Argentine Republic, E. MARIE (*Jour. Agr. Prat., 60 (1896), II, No. 34, pp. 260–263*).

Fattening hogs on alfalfa, F. C. BARKER (*Irrigation Age, 10 (1896), No. 1, pp. 26, 27*).—In a general article on the subject the author recommends alfalfa for hogs.

Water in the economic feeding of horses, H. V. DE LONGEY (*Jour. Agr. Prat., 60 (1896), II, No. 31, pp. 167–171*).

Composition of eggshells (*Deut. landw. Presse, 23 (1896), No. 57, p. 571*).—According to B. Wicke the shells of hen eggs contain 93.7 per cent of calcium carbonate, 1.39 per cent of magnesium carbonate, 0.76 per cent of phosphate of lime, and 4.24 per cent of organic substance.

VETERINARY SCIENCE AND PRACTICE.

Hog cholera and swine plague in Indiana, A. W. BITTING (*Indiana Sta. Bul. 58, pp. 11*).—This consists of brief remarks on the etiology, symptoms, and treatment of these diseases, with an account of answers received in response to circulars sent by the station and

also by the State Swine Breeders' Association to swine breeders in the State asking their experience with the diseases. The replies show that about 8 per cent of hogs perished each year that cholera prevailed, and that the disease was most virulent where the hogs were allowed free access to surface water and wallows. It is believed that medical treatment is of little avail, although the U. S. Prescription, including charcoal, sulphur, several sodium salts, and antimony sulphid, was as efficacious as any during the present season. As preventives are recommended water from wells or springs, clean quarters, care in feeding, and caution against infection by diseased hogs from other sources. The Indiana laws relating to hog cholera are quoted, and the answers received from the swine breeders of the State are condensed and tabulated.

The direct transmission of infectious entero-hepatitis in turkeys, V. A. MOORE (*U. S. Dept. Agr., Bureau of Animal Industry Circular 5, pp. 8, figs. 7*).—This briefly recounts the nature of the disease, with illustrations of normal and diseased cæca and livers, and gives the result of experiments made to ascertain if the affection could be directly transmitted from diseased to healthy turkeys. In November, 1895, 3 turkeys supposedly ill with this disease were shipped from Rhode Island to this Department. One of the turkeys was dead upon its arrival, but the other 2 were placed in the yard with 6 healthy turkeys. The dead turkey was found upon *post-mortem* to be affected with the disease, and microscopical examination revealed the presence of the specific protozoan parasite. The liver and cæca of the dead turkey were chopped up and fed to the healthy ones. In addition, the feces of the other turkeys suspected of having the disease were mixed with the food given the healthy turkeys. One of the Rhode Island turkeys died from the disease 4 days after its arrival and its viscera were fed to the other turkeys. In the 6 weeks following 3 of the healthy turkeys became affected with the disease, and died from it. In January the remaining 3 were killed and one of them showed evidence of the disease. The third of the turkeys received from Rhode Island showed no symptoms of the disease and neither died nor was killed. The experiment is believed to be a conclusive proof of the communicability of the disease by the association of diseased turkeys with healthy fowls.

Prevention of the disease by the destruction of sick turkeys is strongly recommended and the complete disinfection of infected localities urged, the cleansing to be done by the use of slacked lime in turkey yards and the washing of infected places with the following: Crude carbolic acid, ½ gal.; crude sulphuric acid, ½ gal.; water, 19 gal.

Tuberculosis, F. W. BREWER (*Utah Sta. Bul. 41, pp. 27, pls. 2, figs. 5*).—This bulletin gives a popular and general discussion of the subject of tuberculosis, both of animals and man. The nature of the bacillus is discussed and the formation and appearance of tubercles briefly described. The method of injecting tuberculin into suspected

animals for the purpose of detecting the disease in its early stages is noted. Great care in selecting cattle, promptness in removing and destroying those diseased, and thorough disinfection of the infected places are urged. In addition are given tabulated data showing the temperature records of various members of the station herd when injected with tuberculin, with notes on the *post-mortems*, and illustrations showing diseased tissues and scenes in the station laboratories.

Principles of horseshoeing, E. P. NILES (*Virginia Sta. Bul. 46, pp. 131–138, pls. 2*).—In this bulletin the anatomical structure of a horse's foot is described and illustrated, and directions given for properly leveling the foot to receive the shoe and for applying the shoe. It is stated that the foot should be pared until the angle of the wall of the hoof at the toe ranges from 50 to 55°, and that the sole of the foot should ordinarily not be touched with the tools in preparing the foot for the shoe. The sole-bearing surface of the shoe must be perfectly level, and the hoof trimmed so as to rest evenly upon it at all points. The practice of fitting the shoe hot is strongly condemned, and the use of 3 or 4 small nails for fastening on the shoe is recommended. Shoes should be reset every 4 or 6 weeks.

Veterinary materia medica for farmers, E. P. NILES (*Virginia Sta. Bul. 45, pp. 121–123*).—This is a continuation of the popular notes on drugs of importance for treating ailments of farm animals, begun in Bulletin 43 (E. S. R., 7, p. 526). This bulletin contains notes on the physiological and therapeutic action and dose of ammonia, aconite, potassium bromid, chloral hydrate, cannabis indica, areca nut, hyposulphite of soda, creolin, lysol, pyoctanin, and quinin.

Lameness in horses and mules, W. E. A. WYMAN (*South Carolina Sta. Bul. 23, n. ser., pp. 11*).—This bulletin discusses in a popular manner the various causes of lameness in farm animals. Directions are given for diagnosing the exact nature of the lameness and the part affected, the treatment of the special lesions causing lameness is discussed, and prescriptions given for liniments and soothing lotions. In addition, the subject of depraved appetite in horses and mules is briefly noted and prescriptions included for medicines to be given.

Hygiene of the domestic animals, H. GEORGE (*Jour. Agr. Prat., 60 (1896), II, No. 28, pp. 53–55*).—This article treats of the transmission of glanders by public watering places, jaundice in dogs, poisoning of cattle by smut of wheat, foreign bodies swallowed by ruminants, and the dietetic importance of salt.

A wasting disease of cattle (*Deut. landw. Presse, 23 (1896), No. 57, p. 505, figs. 2*).

Arthritis in lambs, J. LA FLIZE (*Jour. Agr. Prat., 60 (1896), II, No. 31, pp. 171, 172*).

A contribution to the etiology of rinderpest, TARTACOVSKY (*Arch. Sci. Biol., 4, No. 3, pp. 295–327; abs. in Centbl. Bakt. und Par. Med., 19 (1896), No. 24, pp. 948, 949*).

Experimental study of translucent tubercles in the lungs of horses, NOCARD (*Berl. tierärz. Wochenschr., 1896, No. 17; abs. in Centbl. Bakt. und Par. Med., 20 (1896), Nos. 4–5, pp. 200, 201*).

A study of the differentiation of the tuberculosis of man and other mammals from that of birds, LEROY (*Arch. méd. expér. et anat. path., 7 (1895), p. 636; abs. in Centbl. Bakt. und Par. Med., 19 (1896), Nos. 16–17, pp. 620, 621*).

A coccidium from the skin of a mouse, A. SCHUBERG (*Verhandl. naturw.-med. Ver. Heidelberg, n. ser., 5 (1896), No. 4, pp. 369–398, pl. 1*).

DAIRY FARMING—DAIRYING.

Corn silage for milch cows, W. P. WHEELER (*New York State Sta. Bul. 97, n. ser., pp. 473–511*).—The results of 10 trials made in different years, where corn silage formed part of the ration, have been averaged and arranged to show changes in yield and composition of milk which have followed changes in food. The tests were made "with cows in a state of lactation when a fair flow of milk of normal composition would be expected, and any general change in quality or quantity of the milk, besides the gradual change as the period of lactation advanced might reasonably be attributed to the influence of the different foods." The average amount of food consumed per cow per day, the composition of the food, calculated digestible nutrients per 1,000 lbs. live weight, yield and composition of milk, and cost per pound of milk and milk constituents are expressed in tabular form for each test.

The cows were fed in every case coarse fodder and a mixed grain ration, the coarse fodder being fed 3 times a day and the grain morning and night just before the coarse fodder. The cost of the rations is based upon wheat bran at $18, corn meal at $20, ground oats at $25, linseed meal at $27, gluten meal at $25, wheat middlings at $20, cottonseed meal at $30, gluten feed at $18, ground flaxseed at $60, hay at $10, corn stover at $6, corn silage at $3, clover silage at $3, roots at $3, and all green fodder at $2 per ton.

Each trial consisted of two or more periods, and corn silage formed part of the coarse-fodder ration in one or more of the periods. The rations approximated those that would generally be made from the materials composing them and were not extreme in any case. Silage was never fed exclusively, but was used once or twice a day with grain, and hay was usually given. In several instances beets, carrots, corn fodder, corn stover, or alfalfa fodder formed a part of the coarse food. The author draws the following conclusions:

"When corn silage replaced some other food or the amount of silage in the ration was increased, there followed in 7 instances a decrease in the cost of milk (5 times, the decrease was slight); once there was a slight increase in the cost and in 1 instance little change.

"There was an increase in the yield of milk in 6 instances (twice the increase was slight) and in 3 instances a slight decrease, less than the normal.

"When the change was from a ration containing corn silage to one containing less silage or not any, there followed an increase in the cost of milk in 4 instances and little change once. There was a decrease in the milk yield in 4 instances (once small—less than normal) and little change in 1 instance.

"When corn silage replaced some other food in the ration or the amount of silage was increased, there followed a decrease in the cost of fat in 6 instances (once but little), a slight increase in cost twice, and little change in 1 instance. There was an increase in the amount of fat in 5 instances (3 times slight), little change in amount 3 times, and a small decrease once.

"When the change was from a ration containing corn silage to one containing less or not any, there followed an increase in the cost of fat in 5 instances (in 3 of them the increase was small).

"There was a decrease in the amount of fat in 3 instances and little change in amount twice.

"When the change in the ration was to more silage or to silage in place of some other food, there followed an increase in the percentage of fat in the milk in 6 instances (3 times the increase was slight), a decrease in 2 instances, and little change once.

"After a change from a ration containing corn silage to one containing less silage or not any, there followed a decrease in the percentage of fat in the milk in 2 instances, an increase in 2 instances (1 of them slight), and little change once.

"In general there has been an increase in milk flow accompanying the use of corn silage in the ration and at the same time an increase in the amount of fat, the percentage of fat not diminishing. At the valuations for foods given, milk has very generally been produced at lower cost and the cost of the production of fat has been lower while corn silage has constituted part of the ration."

The influence of feeding sesamé cake and cotton-seed cake on the butter, V. STEIN (*Tidskr. Landökon., 13 (1895), pp. 664–668*).—Sesame cake was fed to 2 cows in increasing quantities for a period of 49 days, until 5.5 lbs. a day per head was fed. Samples of the cream were churned every 10 days and the butter fat examined by the Badouin test (melted fat shaken with a solution of sugar in HCl, sp. gr. 1.18; giving intense red color in the presence of sesame oil). In no case was a reaction obtained in the fat produced by the cows fed sesame cake.

On the completion of this experiment the same 2 cows were fed cotton-seed cake for 12 days, 2.2 lbs. and up to 5.5 lbs. being fed per head per day. The buttter fat produced gave a reaction for cotton-seed oil with Becchi's test as early as the third day of the experiment, and the reaction was very marked after the sixth day and till the end of the experiment.—F. W. WOLL.

Examinations of the fat globules in cow's milk, G. J. LEUFVEN (*Rep. Ultuna Agl. Inst., 1894, pp. 39–46*).—The author investigated the influence of the feeding of various kinds of oil cakes on the size of the fat globules found in the milk produced by 8 different cows; also the influence of different breeds, and of the time of milking. The oil cakes fed during the different periods of the experiment were palm-nut cake, peanut cake, cotton-seed cake, sunflower-seed cake, and rape-seed cake, 3.3 lbs. in each case, in connection with hay, straw, roots, bran, and ground grain. It was found that no appreciable and pronounced change in the size of the fat globules was brought about by the feeding of these different kinds of oil cakes. On the other hand, the diminution in size of the globules with the advance of lactation was very marked. The author states that an increase in the size of globules seems to occur again in the yellow viscous milk secreted immediately before the cows are dried off. Certain diseases may change the size of globules. Thus an increased size was observed in case of a cow suffering from intestinal catarrh. The proportion of large globules was greater in the evening than in either the noon or morning milk, and larger in the noon than in the morning milk. The ratio between the globules larger and smaller than 0.0022 mm. for the 3 milkings was as follows: Morning 1:12.2, noon 1:10.8, night 1:9.6.

The milk from a number of cows of different breeds and crosses was examined microscopically and the proportion of globules of different sizes determined.

The author finds that in crossing Ayrshire cattle with other breeds the size of the fat globules in the milk of the offspring is determined by the breed with which the crossing is made.—F. W. WOLL.

Statistics of the dairy, H. E. ALVORD (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 11* (*Dairy Bul. 1*), *pp. 53, dgms. 5, map 1*).—This consists of an introductory, a discussion of the agricultural statistics of the Eleventh Census by J. Hyde, general agricultural statistics, cows and cattle of foreign countries by R. A. Pearson, and dairy statistics later than 1890 for several States.

In the introductory the object and purpose of the Dairy Division are discussed, and remarks are made on dairy statistics, the relative importance of the dairy, estimates for 1895, and needed improvement in dairy cattle.

"At the close of the year 1895 the cows which may properly be regarded as dairy animals constitute about one-third of all the neat cattle in the United States, and are about 17,000,000 in number. Dividing these roughly according to their principal products, it may be considered that 11,000,000 cows are primarily butter producers, 1,000,000 cows produce all our cheese, and the milk from 5,000,000 cows is consumed by the families of their owners, or on the farms where produced, or is sold to be consumed as milk, fresh or condensed. . . .

"This gives the grand total value of the dairy products of the country as $454,900,000. If to this be added the skim milk, buttermilk, and whey, at their proper feeding value, and the calves yearly dropped, the annual aggregate value of the products of our dairy cows exceeds $500,000,000. This is regarded as a conservative estimate, and does not include the manure product, which has a very large but quite uncertain value.

"If the value per head estimated for cows in this country, viz, $22 to $25, is accepted, these animals produce nearly 50 per cent more than their own value, annually."

Based on the estimates made, the author believes that "the average cow of the country is far below a standard which is desirable and entirely practicable," and emphasizes the need of continued improvement in dairy cattle. A standard given is 5,000 lbs. of milk and 200 to 225 lbs. of butter per cow annually.

"Every possible influence should be exerted to induce dairy farmers to weed out their herds and keep fewer cows and better ones. At least the average quality of cows kept for dairy purposes should be brought up to a respectable and profitable standard. For the present the cow owner may reasonably require something over 2 gal. of milk per day for 4 months, then 2 gal. a day for the next 4, and at least 2 months more in milk during the year, with constantly decreasing yield. This provides for an annual average yield of 5,000 lbs. of milk, or about 575 gal., which is a fair ideal standard for the dairy cow in the United States."

In the discussion of the statistics from the Eleventh Census, the number and quality of neat cattle, the milch cows on dairy farms, total amount of dairy products, the milk production, and the production of butter and cheese on farms and in factories are considered.

"The increase in the number of milch cows on farms between 1880 and 1890 is the largest ever reported, and in 1890 the number to every 100 of the population (26.4) was greater than at any census since 1860. At the censuses of 1850, 1860, 1870, and 1880 the number of milch cows reported as on farms was 6,385,094, 8,585,735, 8,935,332, and 12,443,120, respectively, the number per 100 of the population ranging from 23.2 in 1870 to 27.5 in 1850. . . .

"The North Central Division [from Ohio to Kansas and north] witnessed during the decade ending with 1890 an exceedingly large increase in the number of its milch cows and, as will be shown hereafter, a remarkable development of its dairy industry. The total number of milch cows reported as on farms in the 12 States comprised in this division is 8,240,999—49.91 per cent of the total number in the United States, and an increase of 2,838,918 upon the number reported from these 12 States in 1880. . . .

"In Iowa there are no fewer than 32 counties in which there are more than 1,000 milch cows for every 1,000 of the population, Delaware County standing at the head of these and all other counties in the United States with the high average of 1,630 to 1,000."

A summary of the number of milch cows and the production of milk, butter, and cheese by States and grand divisions is given in the following table:

Dairy statistics by States.

[From the Eleventh United States Census, 1890.]

States and Territories.	Milch cows.	Milk (all produced on farms).	Butter made on farms.	Butter made at creameries.	Cheese made on farms.	Cheese made at factories.
	Number.	*Gallons.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
The United States	16, 511, 950	5, 209, 125, 567	1, 024, 223, 468	181, 284, 916	18, 726, 818	238. 035, 065
North Atlantic Division	3, 351, 061	1 435, 739, 255	246, 788, 544	48, 245, 172	6, 693, 671	132, 545, 023
Maine	157, 278	57, 969, 791	15, 593, 315	1, 406, 041	696, 052	755, 761
New Hampshire	109, 423	42, 633, 268	7, 942, 840	1, 919, 590	341, 235	103, 386
Vermont	231, 419	90, 712, 230	23, 314, 063	5, 085, 377	609, 586	5, 582, 327
Massachusetts	172, 046	82, 571, 924	8, 358, 703	2. 051, 597	122, 900	262. 633
Rhode Island	23, 943	10, 610, 547	965. 456	233, 783	24, 631	300, 000
Connecticut	127, 892	54, 413, 822	7, 196, 095	3, 173, 164	112. 566	195, 955
New York	1, 440, 230	663, 917, 240	98, 241, 813	14, 485, 702	4, 324, 028	119, 762, 496
New Jersey	161, 576	64, 003. 953	8. 367, 218	499. 531	23, 613	563, 628
Pennsylvania	927, 254	368, 906, 480	76, 809. 041	19, 390, 387	439, 060	5. 018, 837
South Atlantic Division	1, 369, 466	331, 728, 677	78, 270, 911	2, 143, 928	271, 291	144, 000
Delaware	32, 574	10, 699, 362	2, 026, 498	466, 761	359	....
Maryland	142, 198	46, 601, 218	9, 999, 602	847, 277	9, 573	14, 000
District of Columbia	863	459, 978	13, 769	....	....	....
Virginia	273. 634	78, 143, 459	17. 949. 966	811, 890	109, 187	109, 000
West Virginia	188, 492	59. 449, 066	14, 063, 627	18, 000	74, 372	21, 000
North Carolina	223, 416	55, 250, 665	13, 129, 374	....	60. 760	....
South Carolina	107, 184	23, 833. 631	5. 737, 557	....	2. 476	....
Georgia	287, 717	52, 234, 508	14, 483, 323	....	12, 833	....
Florida	113, 388	5, 056, 790	867, 195	....	1, 731	....
North Central Division	8, 240, 999	2, 719, 414, 765	520, 625, 636	129, 925, 952	6. 669, 421	103. 556, 440
Ohio	794, 833	326, 925, 396	74, 990. 307	6, 532, 485	1, 068. 083	21, 185. 971
Indiana	579, 287	200, 510. 797	48. 477, 766	1, 677, 088	360, 948	830, 552
Illinois	1, 087, 886	367, 269. 464	57, 121. 486	25, 553. 422	343, 456	10. 005. 477
Michigan	497, 611	224, 537, 488	50, 197, 481	2, 145, 731	328, 682	5, 041, 778
Wisconsin	792, 620	303, 701. 134	46, 295. 623	14, 059, 876	906, 266	53, 708, 595
Minnesota	593, 908	182, 968, 973	34, 766, 409	13, 911, 095	676, 642	3, 615, 528
Iowa	1, 498, 418	486, 961. 411	72, 893, 079	53, 143, 140	1, 038, 358	4, 705, 576
Missouri	851, 076	193, 931, 103	43. 108. 521	1, 529. 647	288, 620	1, 384. 397
North Dakota	88, 289	26, 566, 112	5, 712, 566	446, 296	131, 374	49. 000
South Dakota	210, 240	59, 666. 525	13. 127, 244	532. 513	303. 951	250, 812
Nebraska	505. 045	144, 768, 263	27. 818, 078	6, 076, 783	463, 831	804, 618
Kansas	741, 786	201, 608, 099	46, 117, 076	4. 317, 876	759. 210	1, 974, 136

Dairy statistics by States—Continued.

States and Territories.	Milch Cows.	Milk (all produced on farms).	Butter made on farms.	Butter made at creameries.	Cheese made on farms.	Cheese made at factories.
	Number.	*Gallons.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
South Central Division	2, 829, 657	519, 693, 663	135, 192, 272	110, 679	318, 367	31, 300
Kentucky	364, 516	118, 497, 289	29, 038, 406	....	64, 822	....
Tennessee	345, 311	107, 657, 116	28, 314, 387	65, 990	69, 919	31, 300
Alabama............	292, 088	55, 508, 687	14, 548, 435	....	6, 131	....
Mississippi	310, 159	50, 803, 371	12, 988, 637	....	4, 898	....
Louisiana............	167, 223	12, 881, 927	2, 089, 774	....	3, 939	....
Texas............	1, 003, 439	118, 475, 320	32, 100, 560	44, 689	145, 730	....
Oklahoma	16, 756	1, 544, 280	387, 920	....	1, 600	....
Arkansas............	330, 165	54, 325, 673	15, 724, 144	....	21, 328	....
Western Division..........	720, 767	202, 549, 207	43, 346, 105	820, 185	4, 774, 068	1, 745, 802
Montana............	24, 143	6, 038, 096	1, 062, 185	....	11, 512	....
Wyoming............	11, 684	3, 064, 588	428, 269	....	15, 196	....
Colorado............	76, 948	19, 680, 791	3, 282, 086	339, 000	87, 183	44, 500
New Mexico	18, 507	717, 155	86, 042	....	18, 931	....
Arizona	4, 874	709, 225	115, 203	....	10, 855	....
Utah	45, 982	8, 614, 694	1, 759, 354	55, 800	163, 539	13, 200
Nevada	9, 273	2, 532, 052	489, 657	....	51, 207	....
Idaho............	27, 278	5, 085, 863	1, 078, 103	13, 650	207, 213	116, 640
Washington	70, 721	19, 873, 281	3, 482, 225	1, 500	71, 281	249, 700
Oregon	114, 156	25, 042, 276	4, 786, 277	138, 468	265, 576	230, 540
California............	317, 201	111, 191, 186	26, 776, 704	271, 767	3, 871, 575	1, 091, 222

"The total production of milk on farms in the United States in the year ending December 31, 1889 (not including farms of less than 3 acres, except where $500 worth of the produce of the farm had been actually sold during the year), was 5,209,125,567 gal., equivalent to 315½ gal. for each milch cow reported on June 1, 1890, and to 83 gal. per head of population.

"The total production of butter on farms (as above defined) in the year ending December 31, 1889, was 1,024,223,468 lbs., as compared with a total of 777,250,287 lbs. in 1879, and the total production of cheese, 18,726,818 lbs., as compared with a total of 27,272,489 lbs. in 1879, an increase of 246,973,181 lbs., or 31.78 per cent in the production of butter on farms, and a decrease of 8,545,671 lbs., or 3 per cent, in the production of cheese on farms. . . .

"The most noteworthy fact in connection with the production of butter on farms is that, notwithstanding the great extension of the creamery system and the decline in the amount of butter annually exported, such production has increased even more rapidly than population. To go back to the census of 1850, it is found that the total production of butter on farms in 1849 was 313,345,306 lbs., or 13.51 lbs. per capita of of population. In 1860 the amount reported was 459,681,372 lbs., or 14.62 lbs. per capita. In 1870 the amount reported was 514,092,683 lbs., which gave an average of only 13.33 lbs. for each inhabitant. Up to this time there had been no creamery butter reported, but in 1880 the production of farm butter averaged 15.50 lbs. for each inhabitant, and that of creamery butter 0.58 lb. for each inhabitant, the total average being thus 16.08 lbs. At the Eleventh Census, however, the production of butter on farms alone averaged 16.33 lbs. per capita of the population, and such had been the increase in the production of butter in creameries that the total production of butter averaged no less than 19.24 lbs. per unit of the population. . . .

"The whole of the States from which a smaller production of farm butter is reported than at the Tenth Census belong to the North Atlantic Division. Every other portion of the country shows an increase in its production of butter on farms, and, as a rule, the States that have witnessed the greatest extensions of the creamery system, such as Wisconsin, Minnesota, Iowa, and Nebraska, show also the greatest increase in the production of butter on farms. The North Central Division, which produced 72.03 per cent of the total production of creamery butter, produced 50.83 per cent of the total amount of farm butter, and its production, both on farms and in creameries, per capita of the population, is much higher than that of any other of the 5 grand divisions of States. . . .

"Of the States in which the production of butter on farms and in creameries is of the greatest importance, relatively to population, Vermont has a production of over 80 lbs. per capita, Iowa of over 60 lbs., South Dakota of over 40 lbs., and Wisconsin, Minnesota, North Dakota, Nebraska, and Kansas of over 30 lbs. . . .

"While nearly 6 times as much butter is made on farms as in creameries, nearly 13 times as much cheese is made in factories as on farms, and while the production of cheese on farms shows a decrease of nearly one-third, such decrease is more than doubly offset by the increase in the production of cheese in factories. It is exceedingly interesting to observe how the production of cheese on farms has gradually given place to the factory system and how the remarkable change that has been brought about is shown in the statistics of successive censuses. . . . In 1870 the factory production amounted to 109,435,229 lbs., in 1880 to 215,885,361 lbs., and in 1890 to 238,013,565 lbs. . . .

"The total production of cheese on farms and in factories per capita of population was not only less in 1889–'90 than in 1879–'80, but even less than in 1849–'50. In Wisconsin this total production in 1889–'90 averaged 33.7 lbs. for each inhabitant, in New York 20.7 lbs., and in Vermont 18.6 lbs. For the entire country, however, the average per capita of population was only 4.10 lbs., of which less than 5 oz. represented the production on farms. Only in California, Idaho, Vermont, Nevada, and Maine did the production on farms average 1 lb. or upward for each inhabitant.

"In connection with the relative decline of cheese making in the United States, of which there is further evidence in the fact that the total production per milch cow in 1889–'90 was 4 lbs. less than in 1879–'80, reference may be made to the fact that the total exports of cheese in the fiscal year ending June 30, 1890, were only 95,376,053 lbs. as compared with a total of 127,553,907 lbs. in the fiscal year ending June 30, 1880."

Tables and diagrams are given showing the total cheese and butter production in 1890 by States; the progress of dairying for half a century; butter, cheese, and condensed-milk factories; and cattle and farm statistics by States.

Dairying in foreign countries is briefly discussed, and statistics and diagrams are given of the cows and cattle in a large number of foreign countries.

"Canada is our chief competitor in the foreign cheese market. Recent statistics show that its dairy interests per square mile are comparatively small. . . . In 1890 the total cheese production of Canada was less than that of New York, and her butter production was slightly greater than that of New York, but less than that of Iowa.

"During the 10 years from 1880 to 1890 the production of cheese in Canada increased 80 per cent and the production of butter 11 per cent. In the same period the cheese production of the United States increased less than 6 per cent and the butter production 50 per cent. In the same time the number of cows increased 16 per cent in Canada and over 32 per cent in the United States, and population increased 12 per cent in Canada and 25 per cent in this country."

The population, number of cows, and production of butter and cheese per square mile in each State and Territory are shown, and the rank of each State and Territory in regard to land area, population, production of dairy products, etc. Some figures are also given on the average value of the cow, the number of cattle of different breeds, and the growth of the factory system in the United States, and in conclusion dairy statistics later than 1890 are given for 15 States.

Report of the Chemical Institute of Budapest for 1895, M. BALLÒ (*Chem. Ztg., 20* (*1896*), *No. 23, p. 218*).—In its control and inspection work the institute examined 1,753 samples of milk and 260 samples of butter. As usual, considerable difficulty was experienced in detecting "half milk," or milk partially skimmed or diluted with skim milk, and the specific gravity of the solids was found very useful in this respect. As an illustration, the data are given for whole milk, skim milk, and a mixture of the two, collected at the central milk depot, as follows:

Analysis of whole milk, skim milk, and "mixed" milk.

	Specific gravity at 15° C.	Specific gravity of solids at 15° C.	Dry matter.	Ash.	Fat.	Solids not fat.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Whole milk	1.0322	1.3370	12.3700	0.6500	3.4500	8.9200
"Mixed" milk	1.0325	1.3700	11.6200	.6700	2.7800	8.8400
Skim milk	1.0347	1.5430	9.5100	.6800	.4400	9.0700

Except for the specific gravity of the solids, the mixed milk is said to be within the limits for whole milk. To prevent diluting milk with skim milk, the following limits were fixed for milk in Budapest: Specific gravity of milk at 15° C., 1.029 to 1.034; specific gravity of serum, at least 1.0265; dry matter, at least 12 per cent; fat, at least 2.8 per cent; solids-not-fat, 8.1 to 9.3 per cent. The milk of cows in the neighborhood is said to contain rarely less than 3.5 per cent of fat.

Analyses are given of 4 samples of goose fat tried out by the analyst.

Further experiments in cream ripening: Flavor, aroma, acid, H. W. CONN (*Connecticut Storrs Sta. Bul. 16, pp. 16*).—This bulletin gives a popular report on the results of bacteriological studies of cream collected at a number of creameries in Connecticut during May and June, and also during the fall and winter. From the cream as many different species of bacteria as possible were isolated and studied. The detailed results of these studies are not given.

"[There were found] bacteria of all the general types, some producing lactic acid and rapidly souring milk and cream, others developing an alkaline reaction and curdling the milk by the production of rennet, others again exerting a putrefactive effect upon the milk, and still others that have seemingly no effect whatsoever upon the milk or cream. The various types were in almost equal abundance among the species collected, except that the number of forms that have no appreciable effect upon milk is considerably larger than those belonging to any of the other classes.

"In the early summer the variety of bacteria found in the cream has been found to be greater than at the other seasons of the year thus far tested (no examinations have yet been made of the cream of the late summer or early fall). In nearly all of the samples of cream collected in May, and particularly in June, the number of different species was very great, not only when different samples were compared with each other, but in the same sample of cream. This would naturally have been anticipated and is probably closely associated with the green food of the cows. It appears not unlikely that in this fact lies the explanation of the high quality of butter flavor commonly developed during these months. Not only is the variety greater, but the number of bacteria found in the cream during these months is vastly in excess of that found under similar conditions in the cooler months of the year."

In one series of experiments the milk of 8 cows kept in the same barn in adjoining stalls and fed in the same manner was tested individually, the milk from each cow being drawn into sterilized bottles. These tests were repeated a number of times. The number and kind of bacteria in the milk of the different cows varied greatly, and "no 2 of these 8 samples of milk, when left to themselves and carefully guarded from outside contamination, underwent the same kind of fermentation." The milk of the same cow at different times also differed as to its bacterial flora. During the year the author separated about 70 different species of bacteria from milk and cream, and of these about 55 have been tested in ripening cream to determine their effect upon the butter. In making these tests 4 lots of cream were pasteurized, 3 lots being subsequently inoculated with the culture of the same bacteria, and the fourth not inoculated. After ripening, the cream was churned and the butter tested.

Some of the deductions from these studies were that the fermentation in the inoculated cream was very different from that in control or uninoculated cream; that most of the bacteria found in cream are harmless or beneficial; that flavor is independent of acid, and that aroma is independent of flavor and acid.

"Of the species of bacteria producing good flavors in the butter the majority were of the acid-producing class; 8 were lactic organisms, 6 were among the class which would be described as alkaline species. . . .

"Independent of the acid it is doubtful whether there was enough difference in the flavors produced by the 2 classes of organisms to enable us to separate them from each other in this way.

"Of the 9 species described as producing injurious effects upon the butter, 6 belonged to the acid-producing class, while 3 belonged to the class developing alkaline reaction.

"From these facts it appears to me a safe and perfectly legitimate inference that the flavor is a matter entirely distinct from the acid. . . .

"Among the 55 species studied only 6 have been found as yet to produce an aroma which has been described in my notes as a good typical butter aroma; [and] none has been among the acid-producing organisms. The 6 either develop an alkaline reaction or have no especial effect upon the reaction of the milk. . . .

"It is, however, interesting to note that in the hands of European bacteriologists, so far as their experiments have gone, somewhat similar results have been obtained. There are upon the European markets several different kinds of pure cultures of bacteria used by creameries for ripening their cream. All of them are of the lactic-acid type and none of them is capable of developing aroma to any considerable extent. . . .

"It is consequently an interesting and an important point if we find that this butter aroma is associated with a different class of organisms from those which produce lactic acid. Herein we probably may find a partial explanation of the reason that the aroma of butter developed during the months of May, June, and July is of a higher character than that produced during other months of the year, since at this period the cream, as already noticed, is provided with a larger variety of bacteria, and therefore among them there is a greater chance of finding not only those producing acid, but also some which give rise to an aroma.

"It has been found in these experiments thus far that none of the 55 species tested

combines all of the 3 characters, the power of producing flavor, acid, and aroma. Some develop flavor with the acid, others develop aroma with flavor, and others develop aroma without any special flavor. . . .

"Lastly, it is interesting to notice that among the species of bacteria which produce good flavor in the butter are found some that were quite widely distributed during the month of June."

Bacteriological investigations in the dairy, G. J. LEUFVEN (*Rpt. Ultuna Agl. Inst., 1894, pp. 35–39*).—*The influence of pasteurization and cooling upon the bacteria content of milk.*—Separator skim milk was pasteurized in a "Separator Heater No. 2" and cooled in a cooler. Samples of milk were taken in sterilized flasks directly before and after pasteurization, and also after the cooling. The flasks were left standing at room temperature until the milk was coagulated. In 6 trials the average length of time before the milk coagulated was: Unpasteurized milk, 58 hours; pasteurized milk, 112 hours; pasteurized and cooled milk, 81 hours. The temperature of the room ranged between 54 and 68° F., the average temperature being 61° F. The results showed that the pasteurized milk became infected while passing over the open cooler. The bacteriological analyses also corroborated this view.

Number of bacteria per cubic centimeter of milk.

Pasteurization temperature.	Unpasteurized milk.	Pasteurized milk.	Pasteurized and cooled milk.
80° C. (176° F.)	1,868,000	1,484,000	1,738,000
85° C. (185° F.)	992,000	150,000	192,000
80° C. (176° F.)	3,200,000	542,000	618,000
75° C. (167° F.)	1,156,000	268,000	284,000

The lactic-acid bacteria proper were killed by the pasteurization, and generally also the peptonizing forms found in the milk, the bacteria remaining being only a few forms, chief among which was a micrococcus present in especially large numbers. This form coagulates the casein to a compact mass after a considerable period of time. The bacteria introduced in the cooled milk were largely lactic-acid forms. The bacteria content of the air of the dairy was found to vary between 71 and 1,248 bacteria per liter.

The bacteria content of the air of dairy and cattle barn.—The air was aspirated through sugar filters and the bacteria content of the same determined. The number of bacteria found per liter of air (September 28) was as follows:

	No.
In dairy:	
Before beginning of daily work	28
At close of churning	56
At close of separation and pasteurization	71
At close of cleaning and scrubbing	26
Before receiving milk	22

At other times considerably higher figures were obtained:

In cattle barn:	No.
5 a. m. before beginning barn work	178
6.30 a. m. at close of milking	193
8.30 a. m. at close of feeding hay	504
1.30 p. m. at close of noon rest	228
5.30 p. m. at close of milking	184

Influence of milking on the bacteria content of milk.—The experiments were made with 3 different cows. The udder and lower parts of cow No. 1 were thoroughly washed and afterwards wiped dry; the udder of cow No. 2 was wiped with a dry towel, as is generally done by Swedish farmers; and that of cow No. 3 was not cleaned at all. Glass dishes 10 cm. in diameter were exposed in each case for a second at the upper rim of the milk pail while the milking was in progress. The number of bacteria found per square decimeter was as follows:

Influence of milking on bacteria content of milk.

Samples taken—	Cow No. 1. Udder washed and wiped.	Cow No. 2. Udder wiped.	Cow No. 3. Udder not cleaned.
At beginning of milking	47	109	210
At close of milking	107	87	101

Investigations concerning the presence of tubercle bacilli in milk.—The milk was examined according to Dr. K. Arnell's method, but with negative results.—F. W. WOLL.

A bacteriological and chemical investigation of kefir, ESSAULOW (*Inaug. Diss. Moskow, 1895; abs. in Ztschr. Fleisch- und Milchhyg.*, 6 (*1896*), *No. 6, p. 110*).—In examining kefir grains of various origin, the author was able to cultivate from them Saccharomyces, *Bacillus acidi lactici*, and *Bacillus subtilis* in every case. He believes all other microörganisms in kefir to be impurities which can cause trouble in preparing kefir milk. Neither of these 3 microörganisms alone can produce anything resembling kefir. *Bacillus subtilis* does not appear to take any part in the preparation of kefir grains (fungi)—it produces a skin or network which takes up the other 2 microörganisms. Alcohol, carbonic acid, lactic acid, and peptone were recognized in kefir.

Cleanliness in handling milk: Bacteriological considerations, H. L. BOLLEY (*North Dakota Sta. Bul. 21, pp. 157–176, figs. 6*).—This bulletin contains popular statements in regard to the souring and other changes in milk, character of bacteria, sources of germs in milk, care of animals in the stable, pasteurization of milk for home consumption, with illustrations, precautions in regard to typhoid fever, and dairy inspection, together with a number of experiments.

In the first experiment the germ content of the air in different localities showed that "a cleanly conducted creamery will show a low atmospheric germ content; and that the air of a good, clean stable

contains many kinds of germs in large numbers, at least, during working hours."

Another experiment showed the variability of the bacteria content of river, hydrant, and well water. An account is given of an outbreak of typhoid fever the source of infection of which "seems inevitably to have been by way of the milk, traceable to a slough and small creek running through the pasture and stable lot of the farm."

An experiment was made on the effectiveness of direct steam for sterilizing milk utensils, the results of which "go to show that 20 minutes' direct steaming will destroy most germs not in spore form."

The results of other experiments are given on the germ content of different kinds of milk and of pasteurized products, the kind and number of germs which may fall into the milk pail during milking, the germs in the milk from the first part of the milking, and on cheese-curd inflation or pin-hole formation. An account of some of the work on cheese-curd inflation has already been given (E. S. R., 7, p. 991).

"The inference to be drawn from these tests is that the germs which originated the gas holes in the curds came from dirt falling from the flanks and udders of the animals.

"Many similar tests, and over 200 qualitative cultural tests upon milk drawn through sterile milk tubes from 13 different cows, during both winter and summer months, at Fargo, substantiate this conclusion. In all these tests of milk from the normal udder no gas-engendering species have been taken. They have, however, often been met with in the milk open to dirt contaminations. Hence one may readily see the economic importance of cleanly methods of work with milk when considered from the standpoint of cheese making."

Power tests of centrifugal cream separators, A. W. RICHTER (*Wisconsin Sta. Bul. 46, pp. 38, figs. 5, dgms. 12*).—"During the past 2 years a series of tests have been made to determine the power required for running the different kinds of centrifugal cream separators in use at the Wisconsin dairy school. In these trials machines have been managed and tests of skim milks made by representatives of the dairy school, instructions of the manufacturers regarding the running of the different machines being strictly adhered to."

Ten belt machines and 3 turbines were tested. Determinations were made in each case of the capacity of the separator as operated, time and power required for starting, and the steam and power required for running. The results are reported in detail and discussed.

Some of the results are given in the following table:

Steam consumption of power separators.

	Rated capacity.	Average capacity as operated.	Steam required per 1,000 lbs. milk, including amount required to start machine.[1]
Belt machines:			*Pounds.*
Reid Improved	2,000–3,000	2,775.0	91.0
United States No. 1	1,800–2,300	2,141.5	67.4
Alpha No. 1	2,000	1,991.7	48.6
Alpha Acme	1,300	1,229.6	59.0
De Laval:			
Standard	1,000	971.5	126.9
United States No.	650	679.2	38.7
United States No. 5	300	331.5	44.5
Baby No. 2	300	283.8	28.3
Turbine machines:			
Alpha No. 1	2,000	2,540.7	88.5
Do	2,000	2,028.9	97.9
Do	2,000	1,698.9	107.6
Imperial Russian	1,200–1,500	2,041.6	84.9
Standard Russian	1,200–1,500	1,148.0	126.8
Do	1,200–1,500	1,420.8	105.2

[1] At the rate of 60 lbs. steam per indicated horsepower per hour.

"According to the above figures, we find a very marked difference in the power required to run the different machines and also in the pounds of steam per 1,000 lbs. of milk as found in the last column. This difference, though it may appear surprisingly great, is easily accounted for upon a close inspection of the different machines. The greater portion of the work required to operate one of these separators is consumed in rotating the separator bowl; the quantity of milk passing through the machine has little effect upon the total power required, and consequently has a great effect upon the amount of steam required to skim 1,000 lbs. of milk. We have, therefore, every reason to conclude that the power required to run the machine varies chiefly with the mechanical construction and speed of the bowl, while the capacity of the machine further affects the amount of steam required per 1,000 lbs. of milk separated. . . .

"Considered from a standpoint of economy in the steam consumption, we find the Baby No. 2 most efficient. It might therefore occur to some of the readers of this bulletin that a number of these separators should be used in preference to one of the larger ones. There are, however, other conditions which must be taken into consideration. For example: Eight machines of the Baby No. 2 will skim as much milk per hour as one machine of the Reid Improved style and will require a little less than one-third the steam. The floor space may be the same in both cases. The first cost of 8 machines of the Baby No. 2 would be much more than when using one of the Reid separators, while the extra work required to operate 8 machines and clean 8 bowls as compared to that required to operate and clean one machine makes the use of the smaller sizes entirely impractical and really places the larger machine ahead of the smaller one in such cases as regards the total final cost.

"The table shows that, generally speaking, the belt separator is more economical than the steam separator, although some of the turbines, especially the Imperial Russian and Alpha No. 1, running at a capacity of 2,500 lbs., compare very favorably with the belt machines, even surpassing a number of them.

"The question often arises, Which of the 2 classes of machines, belt or turbine, is more economical in a skimming station?

"A careful consideration of all points involved, including cost of machine, engine, shafting, running expenses, etc., shows that whatever difference there may be between the 2 styles of machines is on the score of convenience rather than economy."

A table is given showing for different separators the distribution of material in the bowl, weight, speed of the bowl, etc., and these data are commented upon.

Inspection of glassware used by creameries and butter factories to determine the value of cream and milk, J. M. BARTLETT (*Maine Sta. Bul. 26, 2d ser., pp. 4*).—The Maine State legislature of 1895 passed a law entitled "An act for the protection of dairymen," which required that "every individual or corporation buying milk or cream or apportioning its value on the basis of fat content shall have all the bottles and pipettes tested for accuracy, which are used in determining the percentage of fat, and each of these bottles and pipettes shall bear a mark showing that it has been so tested." It is made the duty of the director of the station to test the apparatus, the actual expense being borne by the persons for whom it is done.

"Any person operating the Babcock or other tests for determining the fat in milk or cream which is to be purchased or its value apportioned, must possess a certificate of competency for such work. This certificate is to be issued by the Superintendent of the State College Dairy School in accordance with such rules and regulations as he may devise.

"No one is allowed to use at any creamery, butter factory, cheese factory, or condensed-milk factory where milk or cream is bought or its value apportioned, or to have in his possession, with intent to use, any sulphuric acid of less than 1.82 specific gravity."

The bulletin describes the method of testing the apparatus, and gives a list of the persons who have sent apparatus for testing. The bottles and pipettes are tested by means of mercury. Those found correct are marked "O. K."

"Only about one-half of the creameries of the State have sent their glassware to us. . . . In all, 1,498 cream bottles, 210 milk bottles, and 96 pipettes were received prior to January 1. Thirty-nine of the cream bottles were found to be more inaccurate than the prescribed limit, 0.3 per cent, and were consequently thrown out. Twenty-four of the number, however, were found in 2 small lots, which evidently came from some unreliable manufacturer, as the error found was greater in those, in some cases over 0.5 per cent, than in any other lots. Of the 210 milk bottles all were correct, excepting 33 of one lot of 60. The errors in these bottles varied from 0.3 to 1 per cent.

"The glassware as a whole, however, has been very satisfactory, and the new goods received from the manufacturers since the above act went into force have been exceptionally accurate, showing that the law has had the desired effect. No intentional fraud has been detected, the discrepancies discovered evidently being due to errors in graduating."

Report of the permanent Danish butter exhibitions, F. FRIIS (*Copenhagen, January, 1896, pp. 24*).—The report gives a list of 593 creameries or private dairies which exhibited their butter product during 1895, the creameries being arranged in classes according to the quality of the butter scored. The main results of more general interest refer to the summaries given of the average water content of the butter exhibited, and of the adoption of pasteurization in Danish creameries. In only 5 out of 593 creameries (0.8 per cent) did the butter exhibited during the year have an average water content of over 16 per cent, the highest average being 16.51 per cent. These 5 creameries were all

included among the number in the poorest class. The average percentages of water in the butter placed in the different classes according to the judges' scoring were as follows:

	Per cent of water.
Class A (scoring highest)	13.50
Class B	13.64
Class C	13.68
Class D	13.68
Class E (scoring poorest)	13.79

The average water content for all creameries during the year was 13.70 per cent. The butter from 90 per cent of the creameries averaged between 12 and 15 per cent of water, and that from 42 per cent (250 creameries) between 13 and 14 per cent of water.

Eighty-six per cent of the creameries made butter from pasteurized cream, 44 per cent pasteurizing their cream at all times and 42 per cent a part of the time. Fourteen per cent made butter from unpasteurized cream. Ninety-eight per cent of the butter in the 3 highest classes was from creameries where the cream was pasteurized.—F. W. WOLL.

Some butter investigations, V. STEIN (*Tidskr. Landökon., 13 (1895), pp. 653–663*).—Thirty-two samples of butter and 25 samples of fat from cream churned by the author were examined. The butter was produced on 3 Danish estates and by English analysts had been pronounced adulterated. Most of the cows in the herds in question were far advanced in lactation. The samples were taken between September and March. The limits of the results obtained are shown in the following table:

Results of examinations of butter fat.

Name of estate.	Origin of sample.	Reichert-Wollny method.	Specific gravity at 100° C.	Koettstorf's method.	Iodin number.	Number of samples.
		Cc.		*Mgr. KOH.*		
Bubbel	Butter	22.6–29.6	0.8634–.8658	218.4–228.6	32.0–44.4	11
	Cream	23.1–28.4	.8654 [1]	230.7 [1]	31.9 [1]	6
Hermansminde	Butter	23.9–29.3	.8633–.8644	221.0–228.6	34.8–41.1	10
	Cream	24.3–29.6	....	....	....	10
Söndergaard	Butter	24.5–30.1	.8641–.8653	220.8–228.1	29.1–45.0	10
	Cream	24.8–29.5	....	....	....	....

[1] Single determination.

The lowest figure found for the volatile acids according to the Wollny-Reichert method was in a sample of butter taken in October, when only 15 cows in a herd of 26 head were milking, all of which were "strippers." The author warns dairymen not to export butter made almost exclusively from the milk of old milking cows, and advises sending it to a large creamery where it may be mixed with milk from new milch cows.—F. W. WOLL.

Report of Oerebro Chemical Station and Seed-Control Station for 1894, J. W. WIDEN (*Oerebro (Sweden): 1895, pp. 48*).—This contains the usual accounts of chemical and seed-control work, including analyses of fertilizers (p. 117), feeding stuffs (p. 154), and dairy products. The following average analyses of 61 samples of creamery

butter are given: Water 14.52 per cent (11.66 to 17.80), fat 82.31 per cent (77.75 to 84.76), salt 1.95 per cent (1.5 to 2.5), casein 0.85 per cent (0.78 to 0.96). The last 2 determinations were made in only 3 and 5 samples, respectively.—F. W. WOLL.

The effect of rennet on the proteids of milk and in cheese making, P. HILLMANN (*Inaug. Diss. Leipsic, 1895; abs. in Milch Ztg., 25 (1896), No. 6, p. 86*).—The action of rennet on milk results in 2 albuminoids, one precipitated by the rennet, which the author calls paracasein, and the other whey albumen, which remains in solution. Experiments showed that the time of curdling was affected by the rennet, the temperature, and the dilution of the milk, although the amount of paracasein secured was only slightly affected by the first two. Dilution of the milk diminished the precipitation of paracasein somewhat, and the addition of calcium chlorid of known strength accelerated the curdling and very materially increased the amount of paracasein precipitated. A very little calcium chlorid was found to be sufficient to bring about this increase. The acidity of the milk, which is closely related to the content of soluble lime salts, was also an important factor. Likewise the ash content, especially the lime. Rennet was more effective on the milk of new milch cows than of cows well advanced in the period of lactation, which is attributed to a decrease in lime with the advance of lactation. In other words, a high lime content of the milk accompanied by a high acid content are requisites for a large yield of paracasein, and high lime and acid contents are usually found especially at the beginning of lactation and usually with a high protein and casein content, so that these factors have a perceptible effect on the relative yield of paracasein. The rennet is said also to change the soluble proteids of the milk to a form more difficult to precipitate, *i. e.*, to a certain extent more soluble. It is believed that under conditions especially favorable paracasein can probably be formed from the milk albumen. The author proposes to carry on practical experiments in a cheese factory to determine whether the proportion of curd can be increased by the means suggested.

Feeding milch cows, L. DRUMEL (*Jour. Agr., 7 (1896), No. 76, pp. 163, 164*).

On the fat content of milk and the choice of breeds, K. PLELM (*Deut. landw. Presse, 23 (1896), No. 31, p. 268*).—A popular account of the development of a dairy herd.

The different forms of udders and teats (*Deut. landw, Presse, 23 (1896), Nos. 48, pp. 426, 427, figs. 11; 52, p. 466, figs. 8*).—Extracts from Prof. G. Pusch's new book on the judging of cattle (*Die Beurteilungslehre des Rindes. Berlin: Paul Parey*).

Camels' milk, VON DINKLER (*Pharm. Ztg., 41 (1896), p. 304; abs. in Chem. Ztg., 20 (1896), No. 42, Repert., p. 156*).—The average composition is said to be: Fat, 2.5; casein and albumen, 3.6; milk sugar, 5, and "salts" 0.65 per cent. This places the camels' milk in the first rank as a substitute for human milk. Aside from its composition, it possesses a further advantage over cows' milk of yielding a flocculent curd, similar to human milk, favorable to digestion. Camels' milk is white, sweet in taste and odor, clean and agreeable.

Methods of milk investigation, SOMMERFELD (*Die Methoden der Milchuntersuchung, Berlin: A. Hirschwald, 1896*).

A new butter machine, T. B. O'NEIL (*Amer. Agr. (mid. ed.), 1896, July 25, p. 66, fig. 1*).

Milk registering scales (*Deut. landw. Presse, 23 (1896), No. 65, p. 580, fig. 1*).

The creamery industry, E. E. KAUFMAN (*North Dakota Sta. Bul. 22, pp. 27, figs. 18*).—This is a purely popular bulletin on modern dairy machinery, the advantages of a creamery, testing of milk, the organization and establishment of coöperative creameries, plan for creamery building, outfit required, etc.

Dairying in Australia, A. C. MACDONALD (*Cape of Good Hope Dept. Agr. Rpt. on Dairying in Australia, pp. 93, figs. 61*).—The report is the result of an investigation made by the author at the instance of the local government of the Cape of Good Hope. It gives statistics of the dairy exports of Victoria, showing the increase in the butter export from 369¼ tons in 1889 and 1890 to 11,584¾ tons in 1894–'95; relates the manner in which the government has encouraged the industry, and describes the live stock and dairy management and the creamery management, with numerous illustrations of creamery buildings and equipment. The relative-value plan of paying for milk and cream and several forms of the Babcock test are described in detail, together with refrigerating machines and plants.

Dairying in India, J. W. MOLLISON (*Indian Agr., 21 (1896), No. 1, p. 15*).—Bombay is for India the great center for butter making and for the export trade in butter. Ice is cheap, and good butter can not be made there without it, except in cold weather. Much of the butter is made without ice and will not keep long.

During the past year the average number of pounds of buffalo's milk required to make a pound of butter ranged from 10.5 to 12.7, being the least in the hot season when green fodder was scant.

STATISTICS.

Annual Report of Kansas Station for 1895 (*Kansas Sta. Rpt. 1895, pp. I–XXIV*).—Brief general review of the work of the year, a financial statement for the fiscal year ending June 30, 1895, an inventory by departments, list of previous publications, and a general index to Bulletins 49–56.

Press notes during 1894 and 1895 (*Texas Sta. Bul. 37, pp. 657–739, fig. 1*).—This is a compilation of the more important articles contributed to the agricultural press of Texas by members of the station staff during the years 1894 and 1895. "These articles are of two kinds, (1) those relating directly to results of experiments, and (2) a small number of letters written in reply to actual letters of inquiry upon all the varied subjects embraced in the term 'Texas Agriculture.' An index to this matter is added at the close of the bulletin to assist in locating the special subjects treated in its pages."

The world's markets for American products—Norway (*U. S. Dept. Agr., Section of Foreign Markets Bul. 7, pp. 68*).—Among the topics treated are area and population, finance, agriculture, fisheries, shipping, commerce, customs tariff, and foreign trade. The report of the consul at Stavanger is given.

Arizona agriculture, W. S. DEVOL (*Arizona Sta. Buls. 17, pp. 3–30; 18, pp. 33–54*).—These bulletins consist of a synopsis of the proceedings of a convention of farmers, fruit growers, and stockmen of the Territory held at Phœnix October 18 and 19, 1895, under the auspices of the station and the Phœnix Chamber of Commerce. Popular addresses were made on The Economic Distribution of Water, by J. McMillan; The Adaptation of the Water Supply of Arizona to Its Farmers, by C. W. Crouse; Water Supply, by E. M. Boggs; The Prevention of Blight in the Strawberry and Tomato Plant, by A. C. Lockwood; Economic Fungi, by J. W. Toumey; The Experiment Stations, by W. S. Devol; Cattle Feeding, by F. A. Gulley; Dairy Advantages of the Salt River Valley, by F. A. Hough; Alkali, by R. H. Forbes; Cañaigre, by R. H. Forbes; The Growing of Grapes and Their Treatment to the Raisin, by H. H. Logan; Citrus Fruits of the Salt River Valley, by J. S. Tait; and Economic Insects, by J. W. Toumey.

NOTES.

ILLINOIS UNIVERSITY AND STATION.—P. G. Holden, from Michigan Agricultural College, has been elected assistant professor of agricultural physics in the university and assistant agriculturist in the station. J. C. Blair, of Cornell University, has been engaged as assistant in horticulture in the university and station in place of G. W. McCluer, resigned. W. J. Fraser has resigned his position as assistant in agriculture and has been elected instructor in dairying in the university and assistant in dairy science in the station, *vice* W. A. Powers, resigned. T. I. Mairs, of the Missouri University, has been engaged by the director to superintend field experiments. The chemical laboratory, which was partly destroyed by fire in August, has been repaired and is again in use by the chemical department of the university. Temporary quarters for the chemical department of the station have been provided in Natural History Hall.

INDIANA STATION.—W. B. Anderson, B. S., a graduate of the School of Agriculture of Purdue University, class of '96, has been appointed assistant agriculturist in the station. Important improvements have been made in the construction of new accommodations for the chemical and veterinary departments. Both of these departments now have laboratories with superior appointments.

MAINE STATION.—Fred C. Moulton, assistant chemist, has resigned, and his place has been filled by Henry B. Slade, a graduate of Brown University. L. J. Shepard was appointed September 1 as assistant horticulturist, *vice* H. P. Gould.

OREGON STATION.—H. B. Miller has been elected president of the State Agricultural College and director of the station.

TEXAS STATION.—James Clayton has resigned his position as associate professor of agriculture in the college and agriculturist to the station, and B. C. Pittuck, a graduate of the Texas Agricultural and Mechanical College, has been appointed assistant in agriculture in the college and station.

VIRGINIA STATION.—Dr. F. S. Roop has been appointed assistant veterinarian to the station.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

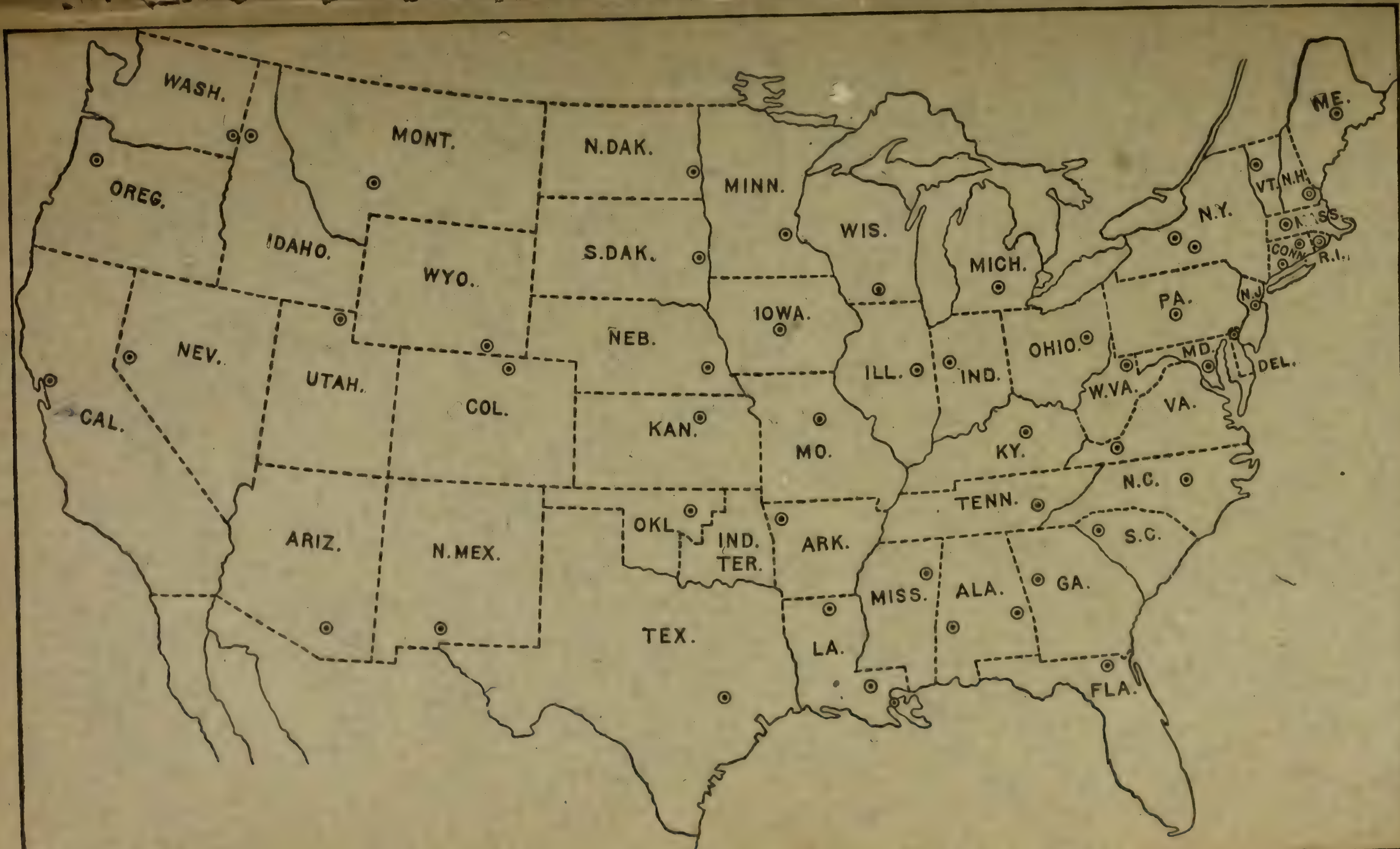
Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1–11; Vol. VIII, No. 1.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894; No. 20, Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Chicago, Illinois, October, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895; No. 24, Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., November 13–15, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Denver, Colorado, July 16–18, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University, Lafayette, Indiana, in 1895.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use.

Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII

No. 3

EXPERIMENT STATION RECORD

WASHINGTON
GOVERNMENT PRINTING OFFICE
1896

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
WALTER H. EVANS, PH. D.—Botany and Diseases of Plants.
——— ———, —Horticulture, Entomology, and Veterinary Science.
L. P. SMITH—Field Crops.
C. F. LANGWORTHY, PH. D.—Foods and Animal Production.
F. H. HALL—Statistics and Bibliography.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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SUBJECT LIST OF ABSTRACTS.

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BOTANY.

METEOROLOGY.

SOILS.

FERTILIZERS.

FIELD CROPS.

HORTICULTURE.

SEEDS—WEEDS.

DISEASES OF PLANTS.

ENTOMOLOGY.

FOODS—ANIMAL PRODUCTION.

DAIRY FARMING AND DAIRYING.

STATISTICS.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

Vol. VIII. No. 3.

The energy with which the agricultural experiment stations in the United States have undertaken to bring the results of their investigations home to the farmer has excited the admiration of foreign leaders in agricultural progress. The system which we have adopted for frequent publication and wide distribution of station bulletins is without a parallel elsewhere. It undoubtedly brings the stations close to the farmers and secures the support of the people. The labor involved in the preparation of station publications is so great and the funds required for the printing and distribution of these publications constitute so large a share of the total resources of our stations that questions relating to the proper form and style of station publications are worthy of the careful attention of station workers and managers. Already these matters have been much discussed at conventions of station officers and on other occasions. Nevertheless a general survey of our station literature indicates that there is still room for improvement in the manner of presenting station investigations to the public.

It is taken for granted that in a general way station publications may be divided into two classes—technical and popular. In the technical publications accuracy and clearness are the chief elements of style needed to show whether a good piece of work has actually been accomplished. In the popular publications there must be, in addition, a careful consideration of the best way to interest the reader—to instruct him without wearying him, and to leave him with definite ideas of the practical usefulness of the work described. It is granted that the translation of science into the language of the people is a difficult task. But for the very reason that this is so it does not become the writer of station bulletins to give evidence of haste or carelessness in his literary efforts. He can not be allowed to plead pressure of time and other work as an excuse for the slovenly performance of one of his most important duties. It is of comparatively little use to make or record experiments if they are so reported as to confuse or mislead the inquirer after scientific or practical truth.

And what stumbling-blocks we put in the way of our farmer readers by using unfamiliar technical terms when the people's English would have served our purpose far better. We were recently much grieved to find a bulletin from one of our stations, which has a good record for

the readability of its bulletins, marred by this defect. In detailing the results of tests of separators terms are used in this bulletin which may be very familiar to the mechanical engineer, but which are unintelligible to laymen, especially when referred to solely by abbreviations. Such a bulletin should certainly be accompanied by a key or an interpreter. The work reported in this bulletin is of great merit, but in their present form the details are lost to the average reader.

The character of the tables and their relation to the text are matters which are often too slightly considered by the writers of station bulletins. Many readers have an aversion to tables, which is largely to be credited to the blind, involved manner in which data are not infrequently tabulated. Tabulating requires not a little skill and study. The table should have a title explaining what it is about; the column headings should be as brief and plain as possible; as a rule only like measures should be put in the same column, and the table should not cover too many points. It should be so constructed that it will be self-explanatory to a large degree, and will enable the reader to take in the general plan at least at a glance. It is a kind of word picture, and the picture should be so well drawn that the reader will comprehend it without protracted study. Moreover, he should, if possible, be attracted to examine it, and not led to skip it. In a popular bulletin if a table can not be so constructed as to attract the reader, it is at least worth considering whether it should not be omitted or relegated to an appendix.

With regard to illustrations, we hold that they should not be used unless they serve to explain or amplify the text or to instruct the reader at least as well as words can do. To make a picture book of a station bulletin is hardly legitimate, though if the pictures are first class in conception and execution we can condone such a fault. But to print poor pictures which do not really illustrate the text is unpardonable. It is a good rule to make the text as good as you can, and then make the pictures of higher grade than the text.

And when great pains have been taken to write a good bulletin and to procure fine illustrations, why spoil it by sending it to a poor printer or using cheap paper or bad ink? We appreciate the difficulties under which some stations labor in this matter. It certainly is too bad that local laws or regulations should make it necessary to have the people's literature ruined by bad typography. There may of course easily be extravagance in printing, but it is only fair that good type and clean paper should be used in giving to the world what it has cost so much patient effort to obtain.

Least excusable is careless proof reading. We have good reason to know how difficult it is to secure absolute accuracy of detail on the printed page, but when, as in a recent case, a score of errors in spelling is found in a list of plants, not to mention the improper use of capitals and italics, something is wrong.

THE FORMATION OF FAT IN THE ANIMAL BODY

Selik Soskin, Ph. D.

The controversy regarding the formation of fat in the animal organism began with Liebig, who advanced a theory just the opposite of that ordinarily accepted. In 1742 the idea was first advanced by Beccaria, in Bologna, that animals take the substances which form their tissues ready-made from the vegetable kingdom. This theory had many followers, among others Prout, in England, while in France Dumas, a contemporary of Liebig (1842), is especially worthy of mention. The chief point of the theory was that animal fat was derived from the fat of plants.

Liebig[1] disputed this deep-seated belief. He called attention to the relation of the nitrogenous constituents of food to those of the body, and from the fact that Carnivora consume no sugar, starch, or vegetable gums, drew the conclusion that these substances are not really nutrients—that is, they can not build blood. Further, since the nitrogenous constituents of plants and of blood have a similar composition, it follows that the nitrogenous constituents of the food of Herbivora contain the elements necessary for the formation of albumen.

In normal life processes sugar, starch, and vegetable gums undergo combustion in the organism, and are excreted in the form of carbon dioxid and water. That is, they are really fuel, and serve for the production of heat. If, however, respiration is hindered by a lack of exercise or a rise in temperature, fat accumulates in the organism of Herbivora. Fat must have its origin in the nitrogen-free nutrients. Their carbon remains in the body in the form of fat when there is not enough oxygen to burn it to carbon dioxid.

Such was Liebig's new theory. The phenomena of fermentation and decay seemed to strengthen it, as did also the discovery by Huber and Gundlach that bees make wax when fed on wax-free honey. The theory was further strengthened by the discovery by physicians that a formation of fat followed the consumption of food rich in sugar, starch, and similar substances, and also by the observation of farmers in fattening animals with rice, maize, peas, lentils, potatoes, and turnips.

Liebig attempted by the aid of statistics to overturn the theory of Dumas and Boussingault that animals take the substances used in the formation of tissue ready-made from the vegetable kingdom.

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[1]Ann. Chem. und Pharm., 45 (1843), p. 112.

Three one-year-old pigs which were fed for 13 weeks on peas and potatoes yielded on slaughtering from 150 to 165 lbs. of fat. The food consumed contained at most not more than 25 lbs. of fat. In the same way, 2 experiments by Boussingault with cows showed 1,650 gm. and 2,365 gm., respectively, of butter fat in the milk unaccounted for even if it is assumed that all the fat in the food consumed was used for the formation of fat in the body. However, it is a fact that considerable quantities of the fat consumed are found in the excreta.

Boussingault, Dumas, and Payen[1] again attempted to show that sufficient fat was contained in the food of herbivora to account for the fat formed in the organism. They reasoned that wax is formed by bees fed only honey and sugar in just the same way that milk is produced from the tissues of the body when the diet does not contain sufficient fat and protein. In the other cases they explained the fatty tissue gained or the butter fat produced by the assumption of a higher fat content in the food consumed. For instance, they used 7.59 per cent for the fat content of maize, while Liebig considered it only 5 per cent.

Boussingault made 2 new experiments with cows. In the first, 7 cows were fed for one year upon hay. Assuming that it contained 1.8 per cent of fat, the amount consumed would furnish 689 kg. of fat. The milk produced contained only 673 kg. of fat. Assuming that the hay contained 2 or 3 per cent of fat, it would have furnished 766 or 1,149 kg., respectively. In the author's opinion, however, the hay contained even more fat. In the second experiment a daily ration of straw and roots furnished 1,116 gm. of fat to account for 915 gm. in the butter.

The opponents of Liebig, however, were gradually compelled by their own investigations to accept his theory of the formation of fat. This was the case with Dumas and Milne-Edwards, who published their investigations on the formation of wax by bees in 1843. They were followed by Boussingault and Payen in 1845.

Dumas and Milne-Edwards[2] made their experiments with bees as follows: The fat in the bees was determined at the beginning and end of the experiment. The food consisted of pure honey or sugar. If the bees did not draw upon their own tissues, wax must have been formed from the sugar consumed. The first experiment did not substantiate Liebig's view, since each bee produced only 0.5 mg. of wax, although its body contained 2 mg. at the beginning of the experiment. A second experiment, however, furnished a fine proof of the correctness of Liebig's theory. A swarm of bees was fed honey only for 32 days and produced 11.515 gm. of wax, although the honey consumed contained only 0.667 gm. of fat. Each bee produced 0.0061 gm. of wax. The bodies before the experiment contained 0.0018 gm. of fat and 0.0042 gm. at its close, and the weight of each bee had also

[1]Ann. Chim. et Phys., ser. 3, 8 (1843), p. 63.

[2]Ann. Chim. et Phys., ser. 3, 14 (1845), p. 400; Compt. Rend., 17 (1843), p. 531; Ann. Sci. Nat. Zool., ser. 2, 20 (1843), p. 174.

increased 0.106 gm. According to this, each bee must have produced 0.0084 gm. of wax from honey.

On the ground of some experiments in fattening a goose, which he published in 1844, Persoz also concluded that fat was formed from carbohydrates. Persoz fed geese maize and they accumulated more fat than the maize contained. He also fed geese food containing very little or no fat—for instance, maize with the fat removed, potatoes, or starch and sugar—nevertheless the geese gained considerable fat.

In spite of the experiments which had been made and criticised—for instance, Gundlach and Huber's research on the formation of wax by bees, Playfair's on the production of milk by cows, and Persoz's on the fattening of geese—Boussingault[1] made new experiments on the formation of fat with swine, geese, and ducks.

A pig was fed from birth until it was 8 months old on potatoes, skim milk, rye meal, and swill. The food contained 6.72 kg. of fat. At birth the pig's body contained 0.65 kg. of fat, and at the end of 8 months, 15.48 kg.; that is, 14.83 kg. of fat had been formed, although the food consumed contained only 6.72 kg., aside from the amount contained in the mother's milk which the pig consumed during the first 5 or 6 weeks of its life. In another experiment 9 pigs in 98 days produced 43.6 kg. more fat than was contained in the food consumed. In a third experiment 6 geese, which were fed on maize, produced in 31 days 3,290 gm. of fat which must have been formed from the starch of the food.

Following this, Payen, the last of Liebig's opponents, declared his belief in the formation of fat from carbohydrates, and pointed out the experimental errors which had prevented the discovery of the truth for so long a time.

This closes the first period of the history of the question of the formation of fat. It will be seen that in this period practically the same theories were held which are held to-day—a half century later. This standpoint, correctly pointed out by Liebig, was, however, not reached without much opposition from Voit and his followers.

Two decades (1845–1865) intervene between the work of Liebig and Voit. During this time the formation of fat from carbohydrates was so thoroughly believed in that more feeding experiments along these lines were not deemed necessary. The only important investigations were those of Robert Thomson (1847) and of Lawes and Gilbert (1853 and 1862). In studying the effect of various rations on the yield of milk and butter, Thomson[2] observed that the amount of butter increased with the increased consumption of nitrogenous food. He concluded that this "was due to some other cause than chance." Lawes and Gilbert's work will be discussed later.

Aside from these agricultural experiments the question of the formation of fat was touched upon in a few experiments which were made for

[1] Ann. Chim. et Phys., ser. 3, 14 (1845), p. 419; Compt. Rend., 20 (1845), p. 1726.
[2] Ann. Chem. und Pharm., 61 (1847), p. 228.

some other purposes. Thus F. Hoppe[1] discussed the formation of fat from protein in the study of the utilization of cane sugar in the body. In 1859, in his investigation of "the constituents of milk and its early decomposition products" Hoppe[2] found that when milk was allowed to stand for a time exposed to the air the amount of fat in it increased. In 1866 Ssubotin[3] published work which seemed to confirm Hoppe's conclusions. In 1867 Kemmerich found that this increase in the fat content of milk was due to the action of microörganisms. When the spores of these organisms were destroyed by heat and the vessel containing the milk kept sealed, the amount of butter fat and albumen in the milk always diminish, as a result of oxidation processes.

Ssubotin also observed that with dogs the greatest quantity of fat was very often found in the milk when the food consisted of meat. Kemmerich observed this also, and said that it could be stated with almost absolute certainty that butter fat in milk was a cleavage product of albumen radicals.

The gradually accumulating evidence of this nature, together with the medical discoveries which were made, furnished ground for a theory of the formation of fat from protein.

In 1869 C. von Voit[4] reviewed the new theory in a thorough and carefully written article, and sought to overthrow Liebig's theory of the formation of fat from carbohydrates. Liebig's theory was strengthened by the fact that it was possible to transform carbohydrates into many of the compounds nearly related to fats, and also by the fact that the fat in the food consumed was not sufficient to account for the fat actually formed in the body. The compounds just referred to are, however, only lower members of the fatty acid series and could be formed also from cleavage products of albumen. For instance, the drops of oil which are found in some seeds could be derived as well from albumen as from starch, since the parts of plants which contain fat generally contain considerable albumen. In plants oxygen could split off from starch and leave compounds poorer in oxygen, but in the animal organism this is not the case. Oxygen can only be liberated in combination with some of the hydrogen or carbon of carbohydrates.

As an instance of the formation of fat from protein, Voit cited the fact that adipocere is often formed from nitrogenous tissue, muscles, etc., when portions of the animal body are kept under water or when a body is buried in a wet soil. Observations on this subject were made by Fourcroy, Gibbes, Quain, Gregory, G. Liebig, R. Virchow, Wetherill, and Michaelis. It was also observed by Rudolf, Wagner, Husson, Middledorff, and Dawes that testicles, the crystallin lenses, blood, frog muscles,

[1] Virchow's Arch. path. Anat. und Physiol., 10 (1856), p. 144.

[2] Virchow's Arch. path. Anat. und Physiol., 17 (1859), p. 417.

[3] Centbl. med. Wissensch., 1866, No. 22; Virchow's Arch. path. Anat. und Physiol., 36 (1866), p. 561.

[4] Ztschr. Biol., 5 (1869), p. 79.

and cooked albumen were changed into fat when introduced into the abdominal cavity of living animals. The substances were inclosed in collodium, gutta-percha, organic membrane, or even in glass tubes to prevent the infiltration of fat. Voit very justly observed that the substance inclosed in a glass tube might just as well be kept in a water bath at about 40°, since in this case the body temperature was the only factor which could have any influence. He kept glass tubes containing pieces of meat and cooked albumen for 3½ months in a water bath at 40°. At the end of this time he found an increase in the fat content of the substance, but the amount was very small.

The fact of a fatty metamorphosis and the accumulation of fat in animal organs which was observed and investigated by Fick, Rokitansky, Reinhard, and Virchow; further observations regarding fatty degeneration by Wittich, Förster, Wundt, and others; and the fatty metamorphosis of the entire body of new-born children (Buhl), lambs, colts, calves (Fürstenberg), and pigs (Roloff), were all regarded by Voit as proofs of a very general process which changed protein into fat. Further, there was the increase in fat observed by Blondeau in the ripening of cheese. This was disputed by Brassier, but confirmed by Kemmerich.

All these observations led Voit to make experiments, the purpose of which was to investigate the question of fat formation. The respiration experiments made by him and Pettenkofer[1] in 1861 and 1863 had already convinced him that the carbon which was not recovered in the excretory products was retained in the organism as fat. Some of the experiments on which Voit founded his theory will be discussed in detail.

From February 16 to March 14, 1863, a dog was fed daily 1,500 gm. of meat; 3.8 gm. of the carbon contained in the food was, on an average, not recovered in the excretory products. This small deficit was not regarded as due to experimental errors. Voit believed that the 3.8 gm. of carbon was used in the formation of 5 gm. of fat.

At the meeting of agricultural chemists in Munich in 1865 a paper entitled "The formation of fat in the animal body, and fattening,"[2] was read by Voit, in which he described his experiments with dogs on the formation of fat from protein, and also those on carbohydrates. At this meeting it was decided that independent investigations should be carried on by Voit and G. Kühn with milch cows in order that the formation of fat from protein by Herbivora might be studied.

Voit made 2 experiments in which he fed the cows a ration for increase. He comments on the results of the experiments in these words: "It is very probable that the fat from the food and that from the metabolized protein would account for the fat of the milk, and also a large part of the milk sugar besides."[3]

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[1] Ann. Chem. und Pharm., 2 Suppl., 1862–1863, p. 361.
[2] Landw. Vers. Stat., 8 (1866), p. 23.
[3] Ztschr. Biol., 5 (1869), p. 79.

In calculating the results of these experiments it was necessary for Voit to assume some factor to represent the formation of fat from protein. Although he himself calculated that 40.8 gm. of fat could be formed from 100 gm. of protein, he adopted the figures which Henneberg had found a year before, viz, that 51.4 gm. of fat could be formed from 100 gm. of protein.[1] From the analogous case of the fermentation of sugar Henneberg calculated that the nitrogen of the protein would be split off in the form of urea. With the aid of these figures Voit calculated in his 2 experiments with cows that the fat contained in the food, together with that formed from protein, was sufficient to account for not only the fat in the milk, but also the milk sugar in it. Thus in this case it was possible to disregard carbohydrates entirely in considering the formation of fat, and very probably also in the formation of milk sugar.

Kühn published the results of his investigations in 1868. He fed cows a ration rich in protein and poor in fat, while Voit, as has already been said, fed a fattening ration. In Kühn's first experiment there were 10 to 15 gm. and in the second experiment 35.5 to 39 gm. of fat in the cow's milk in excess of the amount which could be accounted for by the fat and protein in the food consumed. There remained no carbon which could serve for the formation of milk sugar, and its origin must be sought in another source. In the first case there were found 303.5 gm. and in the second case 343.5 gm. of milk sugar.

Voit criticised these experiments on the ground that with such poor food as Kühn fed to his cows the body would lose fat. It was a question if the secretion of milk which was observed could be maintained on such diet; in other words, whether the milk glands when no food was consumed did not use the tissues of the body.

In the formation of wax by bees the value of protein is not so easily seen. In the experiments on this subject by Huber and Gundlach, Dumas and Milne-Edwards the bees made in one case in 6 days an amount of wax equal to 6 per cent of their own weight, and in another case in 32 days an amount equal to 13 per cent of their weight. If protein was lacking in the food the bees could easily have supplied the small amount necessary from their own body tissue.

These experiments only point at a formation of fat from carbohydrates. On the other hand, Berlepsch's experiments, in which the bees were fed with honey and pollen, indicate decidedly a formation of fat from protein; the bees which were fed with honey and 117 gm. of pollen made 33 gm. more of wax than the bees fed with honey alone.

For various reasons Voit doubted the accuracy of the results of experiments made by Liebig, Boussingault, and Persoz on different animals, and did not accept their conclusions. The experiments of Lawes and

[1] W. Henneberg, Landw. Vers. Stat., 10 (1868), p. 437 and footnote p. 456; Tagebl. Naturforsch. Versamml., 1876, Suppl., p. 169. Lawes and Gilbert, Rpt. 22d Meeting British Assn. at Belfort, London, 1853, p. 323.

Gilbert, however, could not be so easily set aside. They fed 9 pigs for 8 to 10 weeks with different rations, and on slaughtering them determined the gains in flesh and fat. In 3 cases the fat and protein of the food was sufficient to account for the gains in fat; and this was the case when the ration contained the greatest amount of protein. In 4 other cases, when the amount of protein consumed was not so great, on an average 29 per cent of the fat accumulated could not be accounted for by the protein and fat in the ration, and must have been derived from carbohydrates. And again, in 2 cases, namely, those in which the most fat was accumulated and the least protein was fed, and the ratio of protein to nitrogen-free nutrients was that which experience has shown to be the most desirable, there was 37 per cent of fat which could have been formed only from carbohydrates. Voit could not deny that these experiments of Lawes and Gilbert indicated that carbohydrates were concerned in the formation of fat, and indeed these experiments opened up a new line of thought, the outcome being that the old idea of Liebig which Voit had opposed was held more firmly than ever.

From experiments made by Voit, Ssubotin, Radziejewsky, and Hoffman (which will be considered in detail later), Weiske,[1] believing that the formation of fat from protein by Carnivora was proved, undertook, in conjunction with E. Wildt, an experiment with pigs. The experiment was begun with 2 animals, but 1 soon died. The ration fed consisted of starch, bran, and potatoes. It was found that the small amount of protein contained in this ration was sufficient for the formation of fat. However, these experiments were very justly criticised. The grounds of the criticism will be considered in another place.

Radziejewsky, Ssubotin, Hoffman, and others endeavored to solve the problem as to whether the fat of the food was really transferred to the fat cells of the body. Up to this time this was the ordinarily accepted belief.

Radziejewsky[2] fed a dog with erucin, the glycerid of ereucic acid, but could find only very small quantities of it in the tissues. Subbotin[3] fed a dog spermaceti and found none at all in the fat cells and only traces in the intestinal fat and internal organs. He therefore concluded that in the case of Carnivora the fat of the food did not pass directly into the fat cells of the body.

Instead of erucin and spermaceti Hoffman[4] fed a dog bacon, which contains a fat normally present in the animal body, and obtained results just the opposite of those of Radziejewsky and Ssubotin. The amount of fat found by him in the dog's body was much greater than could have been possibly formed from protein, and it was proved that the fat of the food passed directly into the cell tissues.

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[1]Ztschr. Biol., 10 (1864), p. 1.

[2]Centbl. med. Wissensch., 1866, No. 23, p. 353; Virchow's Arch. path. Anat. und Physiol., 43, p. 268.

[3]Ztschr. Biol., 6 (1870), p. 73.

[4]Ztschr. Biol., 8 (1872), p. 153.

Perewozudkoff, Will, Ewald, Munk, and Lebedeff also attempted to solve this problem. These investigators were particularly interested in the transformation of fatty acids in the animal body. Radziejewsky fed a dog with mutton-tallow soap, and found that 88.5 per cent of the amount fed was assimilated. Perewoznikoff,[1] who fed a dog a mixture of glycerin and fat-free soap, and also injected in the duodenum of the dog a mixture of soap and glycerin and a soap solution without glycerin, found that fat might be formed in the mucous membrane from soap and glycerin.

In experiments made with live frogs and frog muscles, Will[2] observed the transformation into fat of chemically pure palmitic acid with and without glycerin, and also of saponified palmitic acid. I. Munk,[3] who also furnished proof that fatty acids as well as fats are protectors of protein, fed a dog lard and the fatty acids made from it. He showed, further, that the fatty acids which are generally absorbed as an emulsion are for the most part changed into fat by synthesis with glycerin. A. Lebedeff[4] fed a dog tributerine for a long time, but none of this substance was found stored up in the organism. However, Lebedeff[5] soon reported other experiments in which dogs were fed linseed oil and mutton tallow and these substances were found in their organs and tissues. I. Munk[6] repeated these experiments of Lebedeff with all possible precautions and confirmed his results. Further, the same investigator confirmed the synthesis of fatty acids of the food to neutral fats which he had discovered in an investigation of the chyle. Experiments were made with a dog which had fasted until the body contained no fat. In one experiment he fed erucic acid, and in another the fatty acids which are obtained from mutton tallow, and in each case observed a considerable deposit of the corresponding neutral fats. Finally, in 1890, Munk, together with Rosenstein, confirmed this synthesis by investigations of normal human chyle, which was obtained through a cannula.

The formation of fat in the ripening of cheese and the making of wax by bees were soon shown to be proofs of the new view regarding the formation of fat from carbohydrates. Nadina Sieber[7] investigated 3 sorts of Roquefort cheese in different stages of ripening. The results of the analyses showed that the ripening consisted of a loss of water and the decomposition of protein, but did not include an increase of fat. O. Kellner,[8] who studied the ratio of fat to the constituents of the

[1] Centbl. med. Wissensch., 1876, p. 851.

[2] Pflüger's Arch. Physiol., 20 (1879), p. 255.

[3] Verhandl. physiol. Ges. Berlin, 1879, No. 13, p. 94; Virchow's Arch. path. Anat. und Physiol., 80 (1880), p. 10.

[4] Ztschr. physiol. Chem., 6 (1882), p. 149.

[5] Centbl. med. Wissensch., 1882, No. 8, p. 129.

[6] Du Bois-Raymond's Arch. Anat. und Physiol., 1883, p. 273.

[7] Jour. prakt. Chem., ser. 2, 21 (1880), p. 203.

[8] Landw. Vers. Stat., 25 (1880), p. 39.

cheese which could not be changed by the ripening process, viz, the phosphoric acid and calcium, also found that in the ripening of "Backstein" cheese there was no formation of fat.

W. von Schneider[1] investigated the making of wax by bees, and from his analyses of pollen he showed that Berlepsch's experiment, in which bees were fed with 117 gm. of pollen, indicated that Voit's position was incorrect, and pointed rather to the formation of wax from carbohydrates. The 117 gm. of pollen contained 22 gm. of protein. This could yield at most 12 gm. of wax, but 33 gm. of wax was made. Of this 12 gm. could have been formed from protein, 10 gm. could have existed as wax previously formed in the bodies of the bees, and the remaining 11 gm. must have been formed from carbohydrates. E. Erlenmeyer and A. von Planta-Reichenau[2] made investigations with bees, feeding them sugar (rock candy). From each 8 gm. of sugar consumed there was produced 1.589 gm. of fat which could not possibly have been formed from protein. The nitrogen and fat content of the bees themselves remained unchanged during the experiment—that is, wax was not formed at the expense of their own body protein or fat.

In 1881 the publication of a long series of articles on the feeding of farm animals was begun, which indicated even more decidedly the formation of fat from carbohydrates, and taken in connection with the experiments of Lawes and Gilbert, mentioned above, and the experiments with bees just cited, placed this theory beyond all doubt.

The next experiment which should be cited was made in 1876 and 1877 by Henneberg, Kern, and Wattenberg with sheep. This was the first experiment with Herbivora in which the attempt was made to prove the formation of fat from carbohydrates. Henneberg first called attention to this experiment in its relation to the formation of fat in 1881. Its bearing on the question was observed before this by the investigators, but was first pointed out by E. von Wolff. A sheep was fed for 70 days with lucern hay, maize meal, and turnips. Only 6,872 gm. of fat could have been formed from the fat and protein in the food. However, 9,730 gm. was actually found.

It is possible to criticise these experiments. For instance, this animal may have consumed more food and more protein than other animals in the same series, or too large a factor may have been used in computing the amount of fat formed from protein. But granting all this, the experiment still shows that there was a direct formation of fat from carbohydrates.

F. Soxhlet[3] showed that according to the investigations of Schulze and Barbieri the potatoes which Weiske and Wildt fed in their experiments contained from 35 to 52.6 per cent of non-albuminoid nitrogen, and that therefore only 67 to 85 per cent of the fat formed could have

[1] Ann. Chem. und Pharm., 162 (1872), p. 235.

[2] Bienen Ztg., 1878, No. 16, p. 181; and 1880, No. 1, p. 1.

[3] Ztschr. landw. Ver. Bayern, 1881, p. 423.

been formed from protein, and 15 to 33 per cent must have been formed from carbohydrates. Soxhlet himself made 3 experiments with Yorkshire pigs which he fed with rice, a food poor in protein and fat but rich in starch and also free from amids. One pig gained 10.082 kg., and another 22.18 kg. In one case protein could yield 1.779 kg. of fat, and in the other case 3.685 kg. It will be seen that the pigs produced 5 or 6 times more fat than could have been formed from the protein and fat in the food.

B. Schulze[1] made an experiment with 8 geese. They were divided into groups of 2 each and were fed with different mixtures of rye bran and potato starch. Schulze assumed the formation of fat from asparagin, but it has not been proved, and he calculated the hypothetical quantity of fat by Henneberg's method. In one case 13 per cent and in another 17.6 per cent of the total quantity of fat formed must have been derived from carbohydrates.

N. Tschirwinsky[2] fed pigs with barley alone and with the addition of starch and sugar. In one case there was a gain of 8,576 gm. of fat, and only 3,707 gm. could have been formed from the fat and protein in the food—that is, 4,869 gm. must have been formed from carbohydrates. In another case there was a gain of 5,429 gm. of fat, only 1,525 gm. of which could have been derived from the protein and fat in the food.

S. Chaniewski[3] made experiments with geese, and found a gain of 269 gm., 640.2 gm., and 445.24 gm. in the different cases, of which 75.3 gm., 136.52 gm., and 60.08 gm., respectively, could have been formed from the fat and protein assimilated from the food—that is, 71.7, 78.6, and 86.7 per cent must have been formed from carbohydrates.

As late as 1881 Voit[4] still held to his old opinion, but through the accumulated evidence was compelled to acknowledge the possibility of a formation of fat from carbohydrates. In a lecture "On the formation of fat in the animal body," delivered in 1886, Voit said that he had never denied the possibility of the formation of fat from carbohydrates; he had simply said it was not proved, and if this proof was now furnished it did not follow that he had erred in his judgment. The new experiments of Soxhlet, Tschirwinsky, Schulze, and Chaniewski all contained errors, since all assumed a hypothetical value for the composition of the animal body at the beginning of the experiment which can not always be determined with accuracy by analyzing the flesh of another similar animal. Pettenkofer's respiration apparatus, in which all the excretory products were measured, offered an experimental method free from error.

Erwin Voit and C. Lehmann had made experiments with geese and determined the respiratory products. On the first day of feeding the

[1] Landw. Jahrb., 11 (1882), p. 57.
[2] Landw. Vers. Stat., 29 (1883), p. 317.
[3] Ztschr. Biol., 20 (1884), p. 179.
[4] Hermann's Handbuch der Physiologie, vol. 6.

geese they observed that more oxygen was combined with carbon than was necessary for the formation of fat, and therefore concluded that not fat but glycogen was formed. It was necessary to take carbohydrates into account in considering the formation of glycogen and eventually of 27 gm. of fat per day. One goose produced 22 gm. of fat and another 16 gm. of fat per day from carbohydrates. On an average 17 per cent of fat was produced from the starch assimilated. Indeed, by applying Henneberg's principle of the cleavage of protein without the action of air a maximum of 41 gm. of fat could be formed from 100 gm. of starch, together with 48 per cent of carbon dioxid and 11 per cent of water. Voit believed that it was true that if much starch and little fat and protein were supplied fat would be formed from the starch. The carbohydrates must be far in excess of the amount actually required if fat is to be formed from them. If much fat or protein and little carbohydrates are assimilated from the food, then the first two will account for the fat formed and the carbohydrates will be burned in the organism. Voit therefore held to the idea that the protein and fat of the food were the ordinary sources from which fat was formed in the animal body.

The experiments which have been cited up to this time as proofs of the formation of fat from carbohydrates have been made with Omnivora and Herbivora. Munk and Rubner made experiments with Carnivora—that is, dogs. Munk[1] fed a dog, which had fasted for 31 days and become very poor, 200 gm. of meat daily with starch, gradually increasing the amount of the latter from 250 to 500 gm. In order to protect the protein more fully, for 10 days 100 gm. of gelatin per day was also fed. The dog remained in good health for 23 days, but on the 24th day suffered from diarrhea and the experiment was discontinued. The dog's body yielded 1,070 gm. of fat. Of this at least nine-tenths, or 960 gm., must have been formed during the experiment. The food consumed could have furnished 172 gm. of fat, assuming that 12 per cent of fat can be formed from protein, this being the highest value found by Voit; or it could furnish 490.3 gm. of fat, assuming that Henneberg's figure—51.4 per cent—represents the amount of fat formed from protein. On the last assumption 470 gm. of fat, or 49 per cent, must have been formed from carbohydrates; and even assuming that fat can be formed from gelatin, with Voit's figure 203 gm. and with Henneberg's 162 gm. of fat still remain which must have been formed from carbohydrates.

Rubner[2] fed a dog for 2 days 100 gm. of cane sugar and 85 gm. of dry starch daily, after a preliminary period of 13 days on a meat diet and 2 days of fasting. During the 2 days 89.5 gm. of the carbon consumed was not excreted; of this amount 13 gm. were derived from the fat in the food consumed and the cleavage of the protein; carbohydrates

[1] Virchow's Arch. path. Anat. und Physiol., 101 (1885), p. 91.
[2] Ztschr. Biol., 22 (1886), p. 272.

furnished the remainder, 76.5 gm. Assuming the formation of glycogen, as E. Voit had done in his experiments with a goose, there still remained 41.8 gm. of carbon which it must be assumed was furnished by the carbohydrates. Thus a proof of the formation of fat from carbohydrates in Carnivora also was furnished by Munk and Rubner.

E. Meissl[1] made experiments with pigs, feeding them rations with different nutritive ratios. The pigs were first fed in 2 experiments a ration of rice, the nutritive ratio being 1:11.8 and 1:13.7, respectively. They were then fed a ration of barley, the nutritive ratio being 1:7. And finally they were fed a mixture of rice, meat meal, and slightly sour whey, the nutritive ratio being 1:2.44. The respiratory products were measured with a Pettenkofer respiration apparatus. It was found that in the first experiment, with the wide nutritive ratio, from 88.2 to 88.3 per cent of the fat accumulated must have been formed from starch, and in the second experiment 71 per cent. In the third case (meat meal ration), with a narrow nutritive ratio, 4.6 per cent of the fat must still have been formed from starch. In these experiments 100 gm. of starch yielded 19.6, 23.1, and 11.9 gm. of fat, respectively. The possible theoretical amount is 41.5 per cent of fat. In the rice ration more than one-half and in the barley ration more than one-fourth of the fat theoretically possible was actually formed from carbohydrates. Up to this time Voit had observed the formation of no more than 12 per cent of fat from protein.

Briefly recapitulating, Munk's theory[2] that fat is formed from the excess of fat or fatty acids, carbohydrates, and protein in the food consumed would have been regarded as final but for the new work published from 1891 to 1894. When Pflüger[3] formulated his new theory that protein, when present, was the sole source of muscular energy, he raised the question whether or not it was necessary that a cleavage of protein into fat should take place in the animal body before muscular energy could be produced.[4] He examined in detail all the proofs of the formation of fat from protein offered by Voit. In the first place, Pettenkofer and Voit's computation seemed to rest on a false assumption of the composition of meat. Voit did not take into account the fact that lean meat ordinarily contains 0.91 per cent of fat and 0.5 per cent of glycogen. If on a diet of lean meat all the nitrogen is recovered in the excretory products, but a part of the carbon consumed is retained, it is very possible that protein was split up and used for carrying on the life processes of the organism, while the glycogen and fat contained in the meat consumed was stored up in the body. Further, Voit assumed a higher carbon content and a lower nitrogen content for lean meat than was found by Playfair, Boeckmann, Rubner, and Pflüger. According

[1] Ztschr. Biol., 22 (1886), p. 63.

[2] Munk und Uffelmann, Die Ernährung des gesunden und kranken Menschen, 2d ed., 1891, p. 55.

[3] Pflüger's Arch. Physiol., 50 (1891), p. 98.

[4] Pflüger's Arch. Physiol., 51 (1892), p. 229.

to Playfair and Boeckmann, the ratio of nitrogen to carbon is 1:3.451, according to Voit it is 1:3.684, a ratio 6.7 per cent greater than that of Playfair and Boeckmann. According to Rubner, the ratio of nitrogen to carbon is 1:3.277, and according to Pflüger, who takes into account the glycogen in the meat, it is 1:3.22. The difference between Pflüger's and Voit's ratios is sufficient to account for all the fat which Voit assumed was formed from protein. Pflüger shows this very plainly in most of Voit's experiments. The classic experiments of Pettenkofer and Voit offer no proof of the formation of fat from protein.

The other proofs of the formation of fat from protein were either overthrown by Pflüger or shown to point just as clearly to the formation of fat from carbohydrates as from protein.

Lack of space forbids the consideration of this point in detail, which has been given more fully elsewhere.[1]

The conclusion of Salkowsky and Munk that Pflüger's criticism of Voit is in the main justifiable seems warranted, and it may be said that Pflüger's recalculation of the results has overthrown Voit's fundamental proposition. By his new law of nutrition Pflüger makes the carbohydrates and fat of the food consumed the sole sources of fat.

Among the more recent investigations which have been reported that of a Japanese, Kumagawa,[2] should be mentioned. In his careful résumé, "The formation of fat," he makes the following points: (1) The animal body (dog) under normal conditions has no tendency to produce fat from protein. (2) If protein is supplied in so large a quantity that it exceeds all the needs of the organism the nitrogen-free nutrients supplied with the protein are no longer utilized in the organism, but the fat is stored up and the carbohydrates supplied are transformed into fat and also stored.

Both Pflüger and Kumagawa deny the possibility of the formation of fat from protein which has been so long assumed. Both consider that the fat and carbohydrates of the food are the only sources from which fat can be formed in the organism.

To the practical stock raiser a knowledge of the scientific aspect of the subject is of great value. It is of the utmost importance for him to realize in fattening animals that in addition to a definite quantity of protein, which is absolutely essential, those feeding stuffs must be used which contain an abundance of fat and carbohydrates.

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[1] Soskin, Jour. Landw., 42 (1894).

[2] Mitt. med. Fac. k. jap. Univ. Tokio, 3 (1894), No. 1.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

On the action of certain plant acids on insoluble phosphates in the presence of nitrates, G. LOGES (*Neue Ztschr. Rübenz. Ind.*, *36* (*1896*), *No. 16*, *pp. 173, 174*).—In experiments with H. von Liebig's method,[1] in which 2 gm. of substance is digested for 48 hours, with occasional shaking, with 5 gm. of acid potassium oxalate and 250 gm. of water, 27 to 47 per cent of phosphoric acid of Thomas slag was dissolved, while 40 to 98 per cent of that in mineral phosphates went into solution. The low solubility of the slag was probably due, as pointed out by Emmerling,[2] to the coating of the particles with oxalate. By adding small amounts of nitric acid or nitrates this was overcome. The calcium nitrate formed in this case reacts with the oxalate and sets free the nitric acid, which forms more calcium nitrate, and thus the cycle is repeated. A maximum solvent effect was obtained by adding from 0.8 to 0.16 per cent of nitric acid to the solution, but in no case was the solubility as high as with the mineral phosphates. This modification was tested on a number of samples of slag, with the general result of increasing the solubility about two and one-half times. No effect from the addition of nitric acid was observed in the case of the mineral phosphate.

Tests on slag of different degrees of fineness showed that the solubility increased with the fineness of the particles. The lower solubility of the coarse slag is claimed to be due to the fact that these particles are coated with basic lime-iron silicate, which protects them from the solvent action of the solution. Tartaric and citric acids did not influence the solubility.

Upon the determination of magnesium oxid as magnesium pyrophosphate, H. NEUBAUER (*Ztschr. angew. Chem.*, *1896*, *No. 15*, *pp. 435–439*).—After a long series of experiments, embodied in the article, on the various influences bearing upon the accuracy of the determination of magnesium oxid as pyrophosphate, the author arrives at the following conclusions:

The sodium phosphate should be added quickly to the solution made

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[1] Fühling's landw. Ztg., 1886, p. 65.

[2] Landw. Vers. Stat., 30, p. 109.

alkaline with ammonia. Indeed, theoretically the correct way is to add the sodium phosphate in excess to the slightly acid solution and then precipitate with ammonia.

It is not necessary to remove the ammonium salts by ignition before precipitation, as only ammonium oxalate interferes, and this may be removed by redissolving the slightly washed precipitate in a little hydrochloric acid. adding some sodium phosphate and reprecipitating with ammonia. If this is neglected the results may be slightly too high. The presence of a certain amount of ammonium salts is indispensable to the accuracy of the results. Ammonium oxalate does not hinder the precipitation in the least. For especially small precipitates 24 hours must be allowed for complete precipitation, and during the interval the solution should be vigorously stirred several times. The excess of sodium phosphate must not be too small.

The ignition of the precipitate over the blast lamp, or some similar burner, must continue for at least one-half hour, or until there is no further loss in weight.—C. L. PARSONS.

Precipitation of phosphoric acid in the citrate extract of Thomas slag by means of molybdic solution, M. SCHMOEGER (*Chem. Ztg.*, *20* (*1896*), *No. 51*, *p. 497*).—Two methods were tested. In the first, 50 cc. of the extract was mixed with 50 cc. of the citrate solution used in the ordinary citric-acid method and the phosphoric acid precipitated with 25 cc. of magnesia mixture in the usual way. After weighing, the precipitate was dissolved in hydrochloric acid, the solution digested for some time in the water bath, evaporated to dryness to remove silica, and the phosphoric acid again precipitated in the usual way.

In the second method, 100 cc. of molybdic solution[1] was added to 500 cc. of extract and heated 10 minutes in a gently boiling water bath. The yellow precipitate was dissolved on the filter, and magnesia mixture slowly added to the neutralized (with HCl) and cooled solution.

Comparisons of the methods on 8 kinds of Thomas slag are reported, which show that where silica was not removed both methods gave too high results, this being more marked in the case of the molybdate method than of the citrate method.

An accurate volumetric method for determining phosphoric acid and arsenic acid, A. CHRISTENSEN (*Nord. pharm. Tidsskr.*, *1896*, *p. 77; abs. in Chem. Ztg.*, *20* (*1896*), *Nos. 42*, *Repert.*, *p. 153; 50*, *Repert.*, *p. 171*).—Solutions of phosphoric acid or arsenic acid are heated with a mixture of potassium bromate and iodid. The following reaction occurs with phosphoric acid: $KBrO_3+6KI+6H_3PO_4=6KH_2PO_4+6I+KBr+3H_2O$. The separated iodin is titrated with fifth-normal thiosulphate in the usual manner, each 1 cc. of thiosulphate corresponding to 0.0071 gm. of phosphoric acid.

[1] 100 gm. molybdic acid, 400 gm. ammonium hydrate 0.96 sp. gr., and 1,500 gm. nitric acid 1.2 sp. gr.

The method applied to the determination of phosphoric acid in fertilizers is as follows: Dissolve 4 to 5 gm. of the substance in 20 to 30 cc. of nitric acid (1.2 sp. gr.). Make solution up to 500 cc. and use 20 to 50 cc. for each determination. Dilute to 50 cc. if necessary, and add 1 to 2 gm. of silver nitrate in solid form or concentrated solution. Add slowly from a pipette a warm normal solution of sodium hydrate until the yellow precipitation no longer disappears on stirring, then add drop by drop 10 per cent solution of ammonia until no further precipitation occurs. After boiling 5 to 10 minutes and standing a short time, filter and wash free from lime. To prevent cloudiness of filtrate, wash finally with a 2 to 3 per cent solution of potassium nitrate. Wash the precipitate back into the flask in which the precipitation was made with the same solution, add 3 to 6 gm. of sodium chlorid, and warm a few minutes. Filter the solution of sodium phosphate (Na_3PO_4) thus obtained into a glass-stoppered flask and wash the precipitate with the potassium nitrate solution until the washings are neutral. Add to the filtrate 5 cc. of half normal sulphuric acid, 3 gm. potassium iodid, and 10 cc. of a 5 per cent solution of potassium bromate, dilute to 100 to 120 cc., warm for one-half hour at 40 to 50° C. or allow to stand for a day at ordinary temperature before titrating the separated iodid with thiosulphate solution.

In case of phosphates rich in iron, such as Thomas slag, precipitate the phosphoric acid by either the molybdic or the citrate method, wash the precipitate with 2½ per cent ammonia solution and then with 90 per cent alcohol to remove excess of ammonia. Wash the precipitate into a stoppered flask, add 30 cc. of tenth-normal sulphuric acid for each tenth gram of phosphoric acid present. The following reaction occurs: $2MgNH_4PO_4 + 3H_2SO_4 = 2MgSO_4 + (NH_4)_2SO_4 + 2H_3PO_4$. Titrate the free phosphoric acid in the manner prescribed above.

A study of the Kjeldahl method and its modifications, G. RIVIÈRE and G. BAILHACHE (*Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896), No. 12, pp. 806–811*).—The use of phosphoric acid or bioxid and phosphate of manganese did not give satisfactory results. In the latter case a certain amount of nitric nitrogen was driven off. The use of sesquioxid of iron and sulphate of iron furnished more satisfactory results, but the method is complicated and results in a bulky precipitate when soda is added which interferes with distillation. Vanadic, molybdic, and arsenic acids were tested and were found too slow in action, but boric acid gave quite satisfactory results.

On the assumption that the quickness and completeness of reduction would be promoted by raising the boiling point of the sulphuric acid, varying amounts of sulphate of potash (1 to 10 gm.) were added to the acid. Since the smaller amounts gave as good results as the larger, it was concluded that the increased effectiveness was due to the character of the salt added and not to the increased temperature. Although the mixture gave good results as a rule, its action on substances like horn was too slow, and pyrophosphate of soda (1 to 2 gm.)

was substituted for it. The method used was as follows: Place 0.5 gm. of substance in a 250 cc. flask with 20 cc. of sulphuric acid and 1 to 2 gm. of dry and pulverized pyrophosphate of soda. Incline the flask slightly and heat gently at first until the evolution of fumes of sulphuric acid has subsided and the pyrophosphate has dissolved, which generally requires about 20 minutes, then gradually increase the temperature until the acid boils. Continue the digestion until the solution is limpid and but slightly colored. Cool, dilute with water, remove to a liter flask, add a little litmus solution, and connect with a condenser. Run in soda solution through a funnel until the blue color just disappears on shaking, add 3 gm. of magnesia, dilute to 450 to 500 cc., and distill the ammonia in the usual way. This requires from $1\frac{1}{4}$ to $1\frac{1}{2}$ hours.

Comparative results by different methods are shown in the following table:

Determinations of nitrogen by different methods.

Substance.	Soda-lime method.	Kjeldahl method, using mercury.	Sulphate of potash method.				Sodium pyrophosphate method.	
			10 gm. Decolorized in 1 to 2 hours.	5 gm. Decolorized in 2 to 3 hours.	2 gm. Decolorized in $2\frac{1}{2}$ to $3\frac{1}{2}$ hours.	1 gm. Decolorized in 3 to $4\frac{1}{2}$ hours.	2 gm. Decolorized in 1 to 2 hours.	1 gm. Decolorized in $2\frac{1}{2}$ to 3 hours.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Horn	13.00	13.00	13.15	13.15	13.20	13.20	13.20	13.20
Meat	10.34	10.35	10.41	10.45	10.45	10.45	10.40	10.45
Do	8.65	8.65	8.75	8.75	8.80	8.80	....	....
Do	9.50	9.45	9.30	9.40	9.50	9.55	9.60	9.50
Dried blood	11.40	11.35	11.40	11.45	11.50	11.50	....	....
Do	10.45	10.45	10.55	10.55	10.60	10.65	10.65	10.60
Do	11.20	11.15	11.05	11.10	11.15	11.20	....	....
Fish fertilizer	8.95	8.85	8.95	9.00	9.05	9.00	9.05	9.00
Do	9.95	9.90	10.00	10.00	10.00	10.00	....	....
Do	10.15	10.00	10.00	10.00	10.10	10.15	10.15	10.10
Pigeon dung	6.95	6.90	....	....	7.15	....	7.18	7.20
Do	6.27	6.27	....	....	....	....	6.30	6.30
Oil cake	5.25	5.25	....	....	5.25	....	5.30	5.25
Fertilizer	2.15	1.95	....	....	2.15	....	2.20	2.15
Do	8.85	8.80	....	....	8.85	....	8.90	8.96
Do	1.90	1.90	....	....	1.95	....	1.95	1.95

The determination of potash, C. FABRE (*Compt. Rend., 122 (1896), No. 23, pp. 1331–1333*).—The method proposed is as follows: The potash salts are evaporated on the water bath with a slight excess of platinic chlorid, adding toward the end of the operation a few drops of aqua regia to destroy ammonium compounds. The residue is taken up in a few cubic centimeters of distilled water and the solution again evaporated to dryness. The residue is ground up in the evaporating dish with a few cubic centimeters of 90 per cent alcohol, collected on a filter, and washed, first with alcohol until the washings are colorless, then with a small quantity of ether. The precipitate is dissolved on the filter with boiling water and to the solution, warmed to about 60° C., purified (washed in alcohol) magnesium powder is slowly added, a large excess being avoided. The reaction which occurs is as follows: $2Mg + K_2PtCl_6 = 2KCl + 2MgCl_2 + Pt$. To prevent the formation of oxychlorid of magnesium it is well to add a few drops of sulphuric acid at the end

of the above operation. The solution is filtered, a slight excess of precipitated carbonate of lime and a little potassium chromate are added to the filtrate, and the solution titrated with tenth-normal silver nitrate.

It is claimed that while the results by this method are not rigorously exact they are sufficiently so for industrial purposes.

The following results were on salts of known composition:

Percentage of potash in different salts.

		Potash—Total present.	Potash—Found by new method.
		Per cent.	*Per cent.*
1	Muriate of potash	47.80	47.60
2	.....do	48.25	48.10
3	Sulphate of potash	49.60	49.50
4	.....do	49.50	49.30

The quantitative determination of crude fiber in foods and condiments, G. BAUMERT (*Ztschr. angew. Chem., 1896, No. 13, pp. 408–411*).—In a paper read before the German Society of Applied Chemistry the author, after speaking of the difficulty of determining crude fiber in foods which have but little of that constituent, recommends the following modification of the Weende method: Two grams of finely ground air-dry substance is moistened with alcohol and a small amount of fine asbestus fiber added. It is then heated for 1 hour with 100 cc. of dilute sulphuric acid (1.25 per cent.) in a covered beaker immersed in a boiling water bath, with frequent stirring. The acid is removed by an asbestus filter, the asbestus and substance washed back, and the whole again treated in the same manner for 1 hour with 1.25 per cent sodium hydroxid. It is then filtered as before, washed, dried, weighed, and ignited as usual, the loss on ignition representing the crude fiber. If the material is rich in fat, treatment with hot 96 per cent alcohol is recommended previous to the analysis.

The results are given of duplicate determinations on 35 samples of wheat and rye, flour, bran, bread, cocoa, potatoes, etc. A difference of 0.2 per cent occurred only once (cocoa).

The author shows by several analyses the influence on the amount of crude fiber of the duration of heating with the acid and alkaline solutions, results being given for ½ hour, 1 hour, and 2 hours, and compared with those by Holdefleiss' method. The fiber diminished with increased times of contact, but the author prefers heating for 1 hour.—C. L. PARSONS.

On the analysis of flour and of fat in wheat and rye flour, E. SPAETH (*Forsch. Ber. Lebensmtl., 1896, No. 6, pp. 251–259*).—The author gives a summary of recent work on the fat of flour, and on the ground of his numerous experiments he advises the use of petroleum ether instead of ordinary ether in the extraction of fat in flour, since in his

opinion extraction with the latter is not complete. The following conclusions are reached:

(1) Low boiling petroleum ether is the only sort suitable for the determination of fat in flours and in vegetable products in general. The fat content of flour gives an idea of its fineness, since the fat bears a definite relation to the increase in bran; that is, to the coarseness of the flour.

(2) The fat in the starchy part of the kernel has a different composition from that of the hull. The latter is richer in unsaturated fatty acids. It is possible that the fat in the starchy part of the grain has undergone polymerization or oxidation on being stored as a reserve material.

(3) The fats of wheat and rye flour are somewhat different, and the difference can serve as a means of identification if the sample is a very fine flour. A determination of the iodin number of fat furnishes no clue to a mixture of wheat and rye flour if both are coarse. The index of refraction of wheat and rye behave differently. That of wheat flour fat stands in inverse proportion to the iodin number. That of rye flour fat increases with the coarseness of the flour.

(4) When flour is very dry the iodin number of the fat is influenced by the polymerization of the unsaturated fatty acids and becomes lower, just as is the case when fat from flour or other cereals is heated for some time. It is best to extract fat in the cold with petroleum ether and remove the latter and dry the fat on a water bath in an atmosphere of hydrogen.

(5) The fat from old flour, which has become moist, has a lower iodin number that the fat from normal flour.

Analysis and composition of canned meats, R. HEFELMANN (*Pharm. Centbl., 36 (1895), p. 652; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 10 (1895), No. 4, pp. 485, 486*).—Methods for sampling and analyzing canned meats are given and a number of analyses made by Naumann, of Plauen, Dresden, are quoted. The chief difference between these methods and those ordinarily followed is in the determination of fat, which was made as follows: Weigh 6 to 7 gm. of the sample in a glass tube 6 cm. long and 1 cm. wide, inside measurement, open at each end; place in a graduated tube; add 25 cc. fuming hydrochloric acid (specific gravity 1.19); place the graduated tube in a cold water bath; heat quickly to boiling, and shake the tube often. In half an hour the protein will be dissolved. Dilute the contents of the tube with 20 cc. cold water, cool to 30°, add 30 cc. ether, and shake gently. Cool, fill the tube with ether, cork it, and shake. Allow the contents to settle 2 hours, note the volume of ether, draw off 20 cc. with a pipette, evaporate the ether in a small beaker glass, dry 1 hour at 100 to 110°, and weigh the fat. From this compute the fat content of the whole sample.

Copper cyanid reagent for the determination of glucose, A. W.

GERRARD (*Jour. Pharm. et Chim., ser. 6, 3 (1896), p. 250; abs. in Chem. Centbl., 1896, II, No. 2, p. 135*).—The reagent originally described by the author[1] is not stable, and the following modification is therefore proposed: Ten grams of Fehling's solution and 40 gm. of water are heated to boiling in a casserole and a 50 per cent solution of potassium cyanid slowly added until the liquid is decolorized or only slightly blue. Another 10 gm. of Fehling's solution is then added and the sugar solution run in from a burette, the liquid being kept constantly boiling, until the blue color disappears. The solution thus prepared is stable through the formation of the double salt $CuCy_2 \cdot 2KCy$.—W. H. KRUG.

On the determination of glucose, CAUSSE (*Jour. Pharm. et Chim., ser. 6, 3 (1896), p. 433*).—In connection with Gerrard's method (see above), the author calls attention to the fact that in 1889 he proposed the use of potassium ferrocyanid to accomplish the same purpose.—W. H. KRUG.

A method for the separation of galactose and arabinose, E. SUBASCHOW (*Ztschr. Ver. Rübenz. Ind., 1896, pp. 270–273; abs. in Chem, Centbl., 1896, II, No. 2, p. 134*).—The method of separating arabinose and galactose depends on the difference in the rapidity with which the respective hydrazids are formed as well as the difference in solubility of these compounds.

Galactosebenzhydrazid is formed when one part of galactose is heated on the water bath under a reflux condenser with the calculated amount of benzhydrazid and 20 to 23 parts of 96 per cent alcohol according to the reaction: $C_6H_{12}O_6 + C_7H_8N_2O = C_{13}H_{18}N_2O_6 + H_2O$. After $1\frac{1}{2}$ to 2 hours the whole mass is liquid, and on cooling a small amount of galactosebenzhydrazid separates. The greater portion is obtained only after evaporating to $\frac{1}{3}$ or $\frac{1}{4}$ of the original volume. Arabinosebenzhydrazid is formed in a similar manner. The arabinose dissolves almost immediately, and after 15 to 20 minutes the arabinosebenzhydrazid begins to separate. After further boiling for half an hour and cooling the compound separates completely.—W. H. KRUG.

Determination of the diastatic power of malt, W. J. SYKES and C. A. MITCHELL (*Analyst, 21 (1896), May, pp. 122–128*).—The authors give the following method, which is a combination of those of Kjeldahl and Lintner. The soluble starch, malt extract, and diastase solution are prepared as usual. One hundred cubic centimeters of the soluble starch solution and 1 cc. of the malt extract are placed in a 200 cc. flask having a wide neck, well shaken, and allowed to stand 1 hour at 70° F. Fifty cubic centimeters of Fehling's solution is then added, the mouth of the flask covered with a watch glass, and the liquid heated to 98°. The flask is then placed in boiling water for 7 minutes. The Cu_2O is collected in a Soxhlet tube, reduced with hydrogen, and the copper weighed. The weight of the copper divided by 0.438 and multiplied by 100 gives the diastatic power.—W. H. KRUG.

[1] Chem. Centbl., 1893, I, No. 9, p. 445.

The estimation of starch in meat products, J. MAYRHOFER (*Forsch. ü. Lebensmtl. und Hyg. Chem.*, *3* (*1896*), *p. 141*).—The method is based on the power of alcoholic potash solution to dissolve the proteids and fat while the starch remains behind. The substance is treated on the water bath in a covered beaker with 8 per cent alcoholic potash. The liquid is diluted with hot alcohol to prevent the gelatinization of the soap, the insoluble residue collected on a filter, and washed with alcohol. The starch is dissolved by means of aqueous potash solution and reprecipitated with alcohol. It is then collected on a filter, washed with alcohol and finally with ether, and the dry starch weighed. It contains considerable ash which, according to the author, can be avoided by acidifying the solution slightly with acetic acid before precipitating.—W. H. KRUG.

Composition of human fat, C. A. MITCHELL (*Analyst*, *21* (*1896*), *July*, *p. 171*).—Chevreul found that human fat consisted of olein and stearin, while Heintz concluded that it was composed of olein and palmitin with small quantities of several other acids, one of them being liquid. The author concludes from his work that human fat consists of about 70 per cent of liquid acids, principally oleic, 30 per cent of solid acids, probably palmitic, with small amounts of stearic and myristic and traces of lower volatile acids.—B. W. KILGORE.

Determination of volatile fatty acids by the method of Leffmann and Beam, W. KARSCH (*Chem. Ztg.*, *20* (*1896*), *No. 62*, *pp. 607*, *608*).—The author believes that this method—saponification with glycerin-soda solution—is free from the objections of the other methods, and commends it after 2 years of use. He gives comparisons of the method with Wollny's method on 10 samples of butter, each sample being saponified at least twice by both methods. The difference in volatile fatty acids found by the 2 methods ranged from 0.11 to 1.43 cc. and averaged 0.5 cc. decinormal soda solution. The more closely Wollny's directions were followed the more closely did the results approach those by Leffmann and Beam's method. The Wollny method invariably gave the highest results, which leads the author to believe that the results by this method were affected by the absorption of carbon dioxid. Aside from the greater ease and convenience of Leffmann and Beam's method, he believes it is to be preferable from the point of accuracy.

The highest Reichert-Meissl number which the author has found by the Leffmann and Beam method in the butter of the local creamery since the previous October is 30.82 cc. and the lowest 26.53 cc.

On the probable error of the rapid milk testing methods of Babcock, Gerber, and Thörner, compared with the gravimetric (sand) method, H. SCHROTT-FIECHTL (*Milch Ztg.*, *25* (*1896*), *Nos. 12*, *pp. 183–185; 13*, *pp. 199–201; 14*, *pp. 217–220*).—The average results of 200 determinations by these methods are reported.

The average differences between the results by the gravimetric and

the 3 other methods were: Babcock ± 0.095 per cent, Gerber ± 0.067 per cent, Thörner ± 0.076 per cent.

The probable error of determination of each of the 4 methods given was calculated as follows:

Error in different milk tests.

	Gravimetric.	Babcock.	Gerber.	Thörner.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Average error of a single determination	±0.0344	±0.0299	±0.0211	±0.0241
Probable error	± .0232	± .0202	± .0144	± .0162

The author considers the difficulty of accurately reading off the column of fat the main source of error in the rapid milk tests.—F. W. WOLL.

Contribution to the determination of milk sugar in milk and milk products, B. A. VAN KETEL (*Nederl. Tjdschr. Pharm., 8, p. 151; abs. in Chem. Centbl., 1896, II, No. 2, p. 134*).—The author states that in the determination of milk sugar and other liquids it is necessary to first remove the proteids and fat, which is best done by adding phenol and lead acetate. To 50 cc. of milk are added 4 cc. of *phenolum liquefactum* and 10 cc. of a 10 per cent solution of lead acetate, the mixture thoroughly shaken, filtered, and washed until the filtrate and wash water aggregate 100 cc. If the milk sugar is to be determined by Fehling's solution the lead is removed with a few drops of sodium sulphate solution.

Further notes on the detection of formalin, H. D. RICHMOND and L. K. BOSELEY (*Analyst, 21 (1896), April, p. 92*).—The authors found that the ammoniacal silver nitrate reaction, while delicate, was so general as to be misleading, and that Schiff's reagent was delicate but must be performed in slightly acid solution.

In making Hehner's test with sulphuric acid the authors dilute the milk with an equal volume of water and use 90 to 94 per cent sulphuric acid. A violet ring is formed when formic aldehyde is present, and a greenish tinge when none is present. Trillat's dimethylanilin reaction and Plöchl's test are mentioned.—B. W. KILGORE.

The detection of formalin, A. HEHNER (*Analyst, 21 (1896), April, p. 94*).—The author does not consider Schiff's reagent a satisfactory test for formic aldehyde, as it reacts in the same way with other aldehydes and may give indication of the presence of formic aldehyde when none is present on account of the oxidation of the sulphurous acid by the oxygen in the liquid tested. It should only be used as a confirmatory test.

The sulphuric acid test previously mentioned by the author,[1] it is said, will readily detect 1 part of formic aldehyde in 200,000 parts of milk. If milk containing formic aldehyde is allowed to float upon

[1] Analyst, 20 (1895), July, p. 154.

sulphuric acid (about 94 per cent strength) a pale-colored ring forms at the juncture of the two liquids. The milk or food may be distilled and the distillate, to which some casein dissolved in alkali has been added, can be tested as above. This test is characteristic of formic aldehyde and is not given by acetic aldehyde, but when much formic aldehyde is present the blue color is not produced.

An equally sensitive and more generally applicable test for formic aldehyde is made by adding one drop of dilute aqueous solution of phenol to the distillate from milk, mixing, and pouring upon concentrated sulphuric acid, when a bright crimson color appears at the point of contact if formic aldehyde is present. Phenol and sulphuric acid give an orange-yellow color with acetic aldehyde.—B. W. KILGORE.

Note on the estimation of formic aldehyde, H. M. SMITH (*Analyst, 21 (1896), June, p. 148*).—The method is based on the oxidation of formic aldehyde to formic acid in the cold by alkaline potassium permanganate, and the decomposition of this into carbon dioxid and water by boiling and further adding permanganate.—B. W. KILGORE.

Note on Hehner's test for formic aldehyde, N. LEONARD (*Analyst, 21 (1896), June, p. 157*).—The author found that Hehner's test for formic aldehyde in milk (see above) was not easily obtained when pure sulphuric acid was used, but that the commercial acid gave the coloration distinctly and readily. The difference was traced to a small amount of ferric chlorid in the commercial acid, which acted as a feeble oxidizing agent, which is considered necessary to the success of the test.—B. W. KILGORE.

Physical methods of butter examination, N. WENDER (*Ztschr. Nahr. Untersuch. und Hyg. Waarenk., 10 (1896), pp. 46–49, 85–87*).—*The melting test.*—Fifty grams of the butter to be examined is placed in a warm, tall 100 cc. beaker and kept in a drying oven at 60° C. for 30 minutes. The author recommends the method for preliminary work. Pure butter will, as a rule, give a perfectly clear oil, while mixtures of butter and oleomargarine will be more or less turbid.

The emulsion tests.—A review of the methods of Mayer, Jahr, Katz, etc.—F. W. WOLL.

Photometric method for the quantitative estimation of sulphuric acid, J. I. D. HINDS (*Chem. News, 73 (1896), No. 1908, p. 285*).—The author found that by adding solid borium chlorid to sulphuric acid of known strength (very dilute) and observing the height of a column in a cylinder similar to a Nessler cylinder, through which an ordinary candle flame was visible (holding the candle directly under the cylinder and shading the cylinder from direct light), the product of the height of this column by the percentage of sulphuric acid in the solution was a constant. This constant for H_2SO_4 was found to be 0.0590 and for SO_3, 0.0482. Hence the amount of sulphuric acid in dilute solutions can be estimated by adding borium chlorid, observing

the height of the column through which the flame is visible, and applying the following formulas:

$$\text{Percentage of } H_2SO_4 = \frac{0.590}{\text{height of column.}}$$

$$\text{Percentage of } SO_3 = \frac{0.482}{\text{height of column.}}$$

—B. W. KILGORE.

Photometric method for the estimation of lime, J. I. D HINDS (*Chem. News, 73 (1896), No. 1909, p. 299*).—This method is similar to the one for sulphuric acid mentioned above. Solid ammonium oxalate is used as the precipitating reagent and only dilute solutions can be worked, 0.01 to 0.02 per cent giving best results. The method is not adapted to flaky precipitates or ones large enough to settle rapidly. The equations are:

$$\text{Percentage of } CaCo_3 = \frac{0.0642}{\text{height of column} - 0.3}$$

$$\text{Percentage of } CaO = \frac{0.0360}{\text{height of column} - 0.3}$$

For the success of the methods for lime and sulphuric acid the flame must be constant. They are considered especially applicable to the determination of these substances in waters and urine. The author states that the method for calcium carbonate is more accurate than the soap method and is but little affected by magnesium salts.—B. W. KILGORE.

Detection of small quantities of lead in drinking water, M. ANTONY and T. BENELLI (*Gazz. chim. ital., 26 (1896), No. 1, p. 218; abs. in Chem. Ztg., 20 (1896), No. 54, Repert., p. 181*).—To avoid evaporating large quantities of the water, it is recommended to dissolve mercuric chlorid in about 4 liters of the water at the rate of about ½ gm. per liter, and then conduct hydrogen sulphid through the cold liquid. Quantities of lead so small as not to be shown by hydrogen sulphid alone are thrown down with the mercury. If the solution after settling is brown colored, it is shaken with ammonium chlorid (about 5 gm. per liter) and allowed to settle, when it should be colorless. The precipitate is collected on a filter, washed, dried, and incinerated to drive off the mercury. The residue contains the lead, which is treated with sulphuric acid and weighed as sulphate.

A new condenser, R. WALTHER (*Chem. Ztg., 20 (1896), No. 47, p 462, figs. 3*).—This consists of 2 tubes of metal or glass, one within the other, the ends of the outer tube being welded to the inner tube, which is open at both ends, or may be nearly closed at the upper end. The usual inlet and outlet tubes are provided at the upper end of the outer tube, and 2 strips of metal running lengthwise between the inner and

outer tubes cause the water to flow down on the side of the inlet and up on the side of the outlet.

The condenser may be inserted in the distillation flask or in the mouth of an extraction apparatus.

Comparison of methods for the quantitative determination of starch in foods, A. A. LÖSCH (*Inaug. Diss. St. Petersburg, 1896; abs. in Chem. Ztg., 20 (1896), No. 54, Repert., p. 181*).—According to the brief abstract, the best results were obtained when twice as much normal sulphuric acid was used as called for in the method of James Biel. Where 3 times the amount of normal acid was used, the results were too low.

Method for the determination of mustard oil in fodder cake, M. PASSON (*Ztschr. angew. Chem., 1896, No. 14, p. 422*).—The method is clear, accurate, and apparently simple, but requires the figure given in the text for its explanation.—C. L. PARSONS.

On the emulsifying properties of butter and oleomargarine, SCHAEFER (*Milch Ztg., 25 (1896), No. 1, pp. 5–7*).—A discussion of the emulsifying properties of butter and oleomargarine and of the characteristic differences between the two.—F. W. WOLL.

On the detection of adulterations in butter, F. STOHMANN (*Milch Ztg., 25 (1896), pp. 37, 38*).—The author gives a summary of the data obtained for specific gravity, Hebner number, and Reichert-Meissl-Wollny number, by different chemists. References to the literature of the subject are included in the paper.—F. W. WOLL.

Chemistry in daily life, LASSAR-COHN (*Translated by M. M. Pattison Muir. London: H. Grevel & Co., 1896, pp. 324, figs. 21*).—The book is a series of popular lectures. The chemistry of combustion, respiration, nutrition of plants and animals, food, and beverages are among the subjects treated. The chemistry of tanning, dyeing, soap making, photography, and other arts and industries is also treated of.

BOTANY.

Relation of growth of leaves to the carbon dioxid of the air, D. T. MACDOUGAL (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 435, 436*).—A number of experiments were performed in which leaves were allowed to develop in light and in darkness under conditions of functional inactivity. The amount of development depended upon the availability of the stored food, the leaf depending ordinarily upon its own activity for constructive purposes. Many leaves died when inactive in the light due to an insufficient food supply, and the disintegration of the chlorophyll was a result and not the cause of death.

On the resting periods of plants and the means of shortening the same, J. ERIKSSON (*Landmansblade, 29 (1896), pp. 20–25*).—The author discusses the problem of the resting periods of plants under different climatic conditions, and reports the results obtained by the Danish plant physiologist, W. Johannesen, in his experiments investigating the subject. The latter succeeded in shortening the resting period of various plants by exposing the buds or bulbs for 24 hours to an atmosphere saturated with chloroform or ether vapors. Very promising and interesting results were obtained in the work done so far; the study of the subject is being continued by the author.—F. W. WOLL.

Contributions to the physiology of woody plants, K. G. LUTZ (*Beitrag wiss. Bot. Fünfstück, 1 (1895), pp. 1–80; abs. in Jour. Roy. Micros. Soc., 1896, No. 4, p. 440*).—The experiments of the author with beech trees showed that between October 10 and November 10 there was a large transference of starch from the interior of the trunk to the last annual ring and to the bark, and that this starch was then transformed into a fatty oil and glucose. If the leaves were removed, the succeeding growth was destitute of vessels and the tree used up its reserve food material in forming new buds. When pines were stripped of their leaves, very few buds were formed. If this was done early in the season, the reserve materials were used up and no increase in thickness took place.

The point of divergence of Monocotyledons and Dicotyledons, C. E. BESSEY (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 438–440*).—The author gives his opinion relative to the evolution of these great subdivisions of plants.

A comparative study of the development of some anthracnoses in artificial cultures, BERTHA STONEMAN (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 436*).—About 30 species were studied with a view to their separation or definition as based upon their morphological characteristics.

The significance of the compound ovary, C. E. BESSEY (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 434, 435*).—The origin, development, biological significance, and the application in systematic botany of the compound ovary were discussed.

Remarks on the northern species of Vitis, L. H. BAILEY (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 438*).—Notes were given on the systematic position of certain native grapes.

The origin of sugar in the beet, F. STROHMER (*Neue Ztschr. Rübenz. Ind., 37 (1896), No. 11, pp. 137–143*).

A contribution on the anatomy of the fruit of the pear and apple, J. MALFATTI (*Ztschr. Nahrungs. Untersuch. und Hyg., 10 (1896), No. 16, pp. 265–269, figs. 10*).

Abnormal hickory nuts, F. H. HERRICK (*Amer. Jour. Sci., ser. 4, 2 (1896), No. 10, pp. 258–262, pl. 1, figs. 12*).

Sensitive organs of the Leguminosæ and Oxalideæ, M. RODRIGUE (*Arch. sci. phys. et nat., 32, No. 12; abs. in Bot. Centbl., 67 (1896), No. 11, p. 329*).

The most important adaptations for the protection of plant organs, G. RAMME (*Die wichtigsten Schutzeinrichtungen der Vegetationsorgane der Pflanzen, Pt. II, Osterprogramm, Fredk. Real Gymnasium, Berlin, 1895, pp. 25; abs. in Bot. Centbl., 67 (1896), No. 9–10, pp. 289, 290*).

Structures of the embryo sac, J. M. COULTER (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 431*).—The author gives modified definitions of egg apparatus, primary endosperm cell, and antipodal cells.

A contribution to our knowledge of the relation between growth and turgor, E. B. COPELAND (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 432, 433*).—The author reported experiments with seedlings of *Vicia faba* grown at different temperatures. He concludes that rapidity of growth regulates turgor rather than the turgor regulating growth.

Studies in nuclear phenomena and the development of the ascospores in certain Pyrenomycetes, M. A. NICHOLS (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 430, 431*).—As a result of these studies, it is shown that sexual processes may be present in some and absent or degenerate in other members of the Sphæriaceæ. An account was also given of the discovery of nuclei in this family, their structure and behavior during division.

On the formation and distribution of abnormal resin ducts in conifers, A. P. ANDERSON (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, pp. 431, 432*).—Notes are given on the influence of frost, fungus attacks, etc., upon the formation and distribution of resin ducts in *Pinus sylvestris*, *P. strobus*, *Picea excelsa*, and *Abies pectinata*.

The curvature of tendrils, D. T. MACDOUGAL (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 435*).—It is stated that curvature in response to a stimulus is due to the contraction of certain cells on the concave side of the tendrils. It was found that the effects of the stimulus were not transmitted more than 2 cm. from the point of reception.

The influence of rainfall upon leaves, D. T. MACDOUGAL (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 435*).—The investigations of Ridley and Stahl are mentioned and a brief résumé is given of the observations of Junger in the same line.

The forces determining the position of leaves, R. N. DAY (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 430*).—Specimens of Phaseolus, Taraxacum, Cucurbita, Nicotiana, Helianthus, and Arisæma were grown in light and darkness in upright, horizontal, inverted, and planostat positions, and the author concludes that the heliotropic tendency of leaves so far overbalances the other influences as to determine their position; hence it is a physiological and not a mechanical resultant.

Rheotropism and the relation of response to stimulus, F. C. NEWCOMBE (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 433*).—The effect of flowing water as a stimulus is mentioned, those roots curving against the stream being called positively and those with the stream negatively rheotropic. The roots of many plants were shown to be positively rheotropic, while others are unresponsive. The stimulus is not considered as necessarily closely biological, but may be mechanical.

The graft from antiquity to the present time, L. DANIEL (*Le Monde des Plantes, ser. 2, 5 (1896), pp. 73, 89, 106, 113*).

On the supposed immediate effect of pollen, H. J. WEBBER (*Science, n. ser., 4 (1896), No. 92, pp. 498–500*).—The author believes reversion and graft hybridization more responsible for unusual forms of fruit than the immediate effect of a foreign pollen.

Grass flora of Iowa, L. H. PAMMEL (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 432*).—Notes were given of the indigenous grasses of the State, their distribution and relative value.

The distribution of the species of Gymnosporangium in the South, L. M. UNDERWOOD and F. S. EARLE (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 437*).—The distribution of the 6 species parasitic on *Juniperus virginiana* is given, the most common ones being *Gymnosporangium macropus*, *G. clavipes*, and an undescribed species.

Formaldehyde as a preservative of vegetable tissues, J. R. JACKSON (*Gard. Chron., ser. 3, 20 (1896), No. 509, p. 365*).

METEOROLOGY.

On the diurnal variation of rainfall, A. ANGOT (*Compt. Rend., 122 (1896), No. 24, pp. 1409–1411*).—Summarizing the results of daily observations at Paris during 6 years (1890–'95), in 8 3-hour periods, the following figures are obtained, showing the thousandths of the total rainfall during the respective periods:

Rainfall during different parts of the day in summer and winter.

	Midnight to 3 a. m.	3 to 6.	6 to 9.	9 to 12.	12 m. to 3 p. m.	3 to 6.	6 to 9.	9 to 12.
Summer	114	86	90	87	143	223	161	95
Winter	106	142	172	123	120	104	111	122

The average for the whole day is 125. In summer the rainfall falls below this average during 5 periods, or 15 hours out of the 24, from 9 p. m. to noon. In winter, on the other hand, the rainfall exceeds 125 in only 2 periods, 3 to 9 a. m.—that is, at the time of lowest temperature and greatest relative humidity. The most marked variations occurred in May and September. During April, October, and November the daily variations were not appreciable. Since the conditions in summer and winter are almost diametrically opposed, the averages for the year possess no significance.

From observations on the frequency of rainfall during the same period, it appears that the probability of rain for each hour of the day during the summer is 75 out of 1,000. This rises to 104 between 3 and 6 p. m., and is about 71 for the rest of the day. In winter the average probability is 93, rising to 103 between 3 and 6 p. m. and 120 between 6 and 9, remaining constant at about 86 during the rest of the day. The intensity and frequency of rainfall were found to follow the same rule.

Observations with actinometers on Mont Blanc to determine the solar constant, J. VALLOT (*Rev. Scient., ser. 4, 6 (1896), No. 2, p. 53*).—The results obtained by the author in 1887 with the absolute actinometer of Ville and in 1891 with the mercury actinometer of Crova while differing widely from the results of other observers agree closely with each other, although obtained by totally different instruments and calculated by two distinct methods. The solar constant is equal to the quantity of heat observed at a given station increased by the amount absorbed by the atmosphere.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 23 (1895), No. 13, pp. VII, 489–501, charts 5*).—This number contains the title-pages, table of contents, list of corrections and additions, and index for volume 23 (1895) of the Review, and an annual summary of meteorological observations during 1895, "based upon data received from about 3,000 stations occupied by regular and voluntary observers of the Weather Bureau, Canadian data received by

the coöperation of Prof. R. F. Stupart, and Mexican data received from the directors of observatories in that country." Notes and tabulated data are also given by the editor on the annual snowfall and by P. Morrill on the reduction of barometric pressure to the sea level.

In applying the formula proposed by the International Meteorological Committee to the reduction of barometric observations at elevations of 1,000 ft. or more, a difficulty is encountered in determining a proper reduction temperature.

"For several months past the writer has devoted considerable labor to a study of this problem, as presented in our elevated western stations.

"The results obtained may be briefly summarized in the following theses:

"(1) Normal reduction temperatures may be determined from the normal observed temperature reduced to sea level by assuming a decrement of temperature with altitude ranging from 1.5° F. per 1,000 ft. in winter to 2.5° in summer, and being 2° per 1,000 ft. for the average of the whole year.

"(2) Observed temperatures may be reduced to sea-level temperatures (whereby is meant such temperatures as would exist if the present terrestrial surface were replaced by a sea-level plain, while the general features of the atmospheric circulation remained unchanged) by applying to them increments for altitude of the magnitude noted above and further modifying them by local corrections determined as follows: The normal temperatures, increased proportionately to the various altitudes of stations, are to be charted for a considerable extent of country and isotherms drawn. These, while forming a remarkably uniform system of lines as compared with those based on the original observed temperatures, are more or less wavy and irregular as a result of local peculiarities of temperature. Through these wavy lines smooth lines are drawn with a free hand, and the isothermal chart thus formed is believed to closely approximate the desired chart of sea-level temperatures as above defined. Temperatures taken from the latter chart furnished the data required by the first thesis."

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24 (1896), Nos. 1, pp. 1–38, charts 7; 2, pp. 39–68, charts 7; 3, pp. 69–103, charts 9*).—In addition to the usual meteorological summaries, No. 1 contains a special illustrated article on cloud observations and an improved nephoscope by C. F. Marvin, and notes by the editor on cold air in lowlands, Mexican climatological data, thunderstorms and clouds in Jamaica, and recent high balloon ascensions; and No. 3 contains a list of recent publications on meteorology by J. H. McCarty, librarian of the Weather Bureau; an article on the tornado of May 27 at St. Louis, Missouri, by H. C. Frankenfield; and a note by A. J. Henry on tornadoes of April and May, 1896.

Climate and Health (*U. S. Dept. Agr., Weather Bureau, Climate and Health, vol. 2 (1896), No. 2, pp. 37–64, charts 12*).—This number of *Climate and Health* contains climatologic, morbidity, and mortality statistics for the four calendar weeks embraced between February 2, 1896, and February 29, 1896, inclusive.

Meteorological observations, June and July, 1896, L. METCALF and J. L. BARTLETT (*Massachusetts Hatch Sta. Met. Buls. 90 and 91, pp. 4 each*).—The usual notes and summaries.

Meteorological records, E. A. BEALS (*Minnesota Sta. Bul. 46, pp. 390–392*).—Tables are given which show total precipitation at 45 points in the State during each month of 1895; the average annual precipitation at 27 points during 5 or more years; the mean temperature at 41 stations during each month of 1895, and the normal temperatures, monthly and annual, for 28 stations in the State. The normal annual precipitation of Minneapolis is 28.34 in. The precipitation during 1895 was 22.09 in. The normal annual temperature at this point is 42.3° F., and the mean temperature for 1895 was 43.3°.

Meteorological observations, June, 1896, H. B. BATTLE and C. F. VON HERRMANN (*North Carolina Sta. Met. Bul. 81, pp. 91-106, maps 2*).—The usual notes on weather and crop conditions and summaries of meteorological observations.

Meteorological observations, W. B. ALWOOD (*Virginia Sta. Rpt. 1895, pp. 7, 8*).—A summary by months is given of observations on temperature and precipitation for the period from July 1, 1893, to June 30, 1895. "The rainfall during late summer and autumn [of 1894] fell much below the previous year, though it was also a year of drought. The winter was a season of extraordinary severity, both in lowness of temperature and in fall of snow, this being over 6 ft. total on the level for the winter season. . . . The average deficiency of precipitation for the 2 years is 6 in."

WATER—SOILS.

The oxidation of the organic matter of the soil, P. P. DEHÉRAIN and E. DEMOUSSY (*Compt. Rend., 123 (1896), No. 5, pp. 278-283; Rev. Scient., ser. 4, 6 (1896), No. 7, p. 213*).—The oxidation of the humus was measured by the quantity of carbonic acid furnished by various soils under different conditions. Oxidation went on to a certain extent in soils which had been sterilized by heating to 120° C, but it was much less active than where the chemical action was assisted by that of the ferments of the soil. These ferments resist a temperature of 65° C., at which point the oxidation of the humus is at the maximum. The oxidation is favored by free access of air resulting from the stirring of the soil. In warm regions a soil plowed each year and cultivated without fertilizers rapidly becomes sterile on account of the destruction of the humus. In temperate regions the loss of humus is less rapid. It was observed at Grignon that a soil cultivated without fertilizers during six years lost half of its organic matter.

Note on the composition of deposit formed in water pipes, J. A. and E. W. VOELCKER (*Analyst, 21 (1896), July, p. 169*).—The authors found that a considerable deposit of basic carbonate of zinc mixed with the oxid was formed from a soft water in galvanized-iron pipes in which the water was heated.—B. W. KILGORE.

FERTILIZERS.

The marls of Wisconsin, F. W. WOLL (*Wisconsin Sta. Bul. 51, pp. 16*).—Descriptions and analyses of 44 samples of Wisconsin marl are reported, accompanied by notes on the occurrence of marl deposits in the State and on the use of marl as a soil improver and for the manufacture of cement and quicklime. Shell marls are found in a large number of places in Wisconsin, especially in the central and eastern counties. These marls are of a high degree of purity, and are generally found under thin layers of peat or in lake bottoms. They are largely made up of carbonate of lime, and are recommended "as a fertilizer on soils deficient in lime or as an amendment to clay, sandy, or peaty soils." The Wisconsin marls generally do not contain any phosphoric acid or potash, their value depending on the lime and the small amount of organic nitrogen which they contain.

The method of analysis used was briefly as follows:

"Ten grams of marl was treated with strong hydrochloric acid, the digestion being continued for about 30 minutes at boiling temperature. Lime was determined in the extract by the Immendorff permanganate method; the insoluble residue was dried in a platinum gooch, weighed, incinerated, and again weighed. Phosphoric acid and potash were determined in the acid extract and nitrogen in the original substance."

Fertilizer experiments conducted at the Royal Swedish Agricultural Academy during 1895, L. F. NILSON (*Kgl. Landt. Akad. Handl., 35 (1896), pp. 64–86*).—The experiments were conducted with sugar beets and barley grown in marsh soil, the object being to study the effects of potassic or phosphoric acid fertilizers on the growth and composition of these crops. The soil used in the experiments was from a marsh on the Island of Gotland, and contained 5 to 10 per cent of lime in the dry substance and 4 to 5 per cent of nitrogen in the organic matter of the soil. The crops were grown under three different conditions: (1) In glass cylinders, 80 by 27 cm. and with a surface of 572 sq. cm.; (2) in cement-lined boxes placed in the ground, 1 square meter surface, arranged to be watered from below; (3) in zinc boxes, also placed in the ground, with a surface area of 0.3 square meter.

In the potash experiments with sugar beets a basal fertilizer at the rate per acre of 178.2 lbs. of phosphoric acid (in the form of Thomas slag) and 21.3 lbs. nitrogen (in the form of nitrate of soda) was applied. The beets grown were of the Kleinwanzleben variety. The following main average results were obtained:

Potash experiments with sugar beets grown in marsh soil.

No. of trials.	Potash (K_2O) applied per hectare.	Average weight of beets.	Sugar content of beets.	
		Grams.	*Per cent.*	*Grams.*
	Glass cylinders, 572 sq. cm. surface, 1 beet:			
5	None	1, 312	14.23	186.6
15	200 to 400 kg. in form of sulphate	2, 362	16.21	383.1
15	200 to 400 kg. in form of muriate	2, 325	16.61	386.3
	Cement-lined boxes, 1 square meter surface, 25 beets:			
1	None	5, 230	14.23	744.2
2	300 to 400 kg. in form of sulphate	6, 055	16.04	971.0
2	300 to 400 kg. in form of muriate	6, 215	16.46	1, 023.2
	Zinc boxes, 0.3 square meter surface, 6 beets:			
5	None	1, 354	13.55	183.5
15	200 to 400 kg. in form of sulphate	2, 434	15.70	382.2
15	200 to 400 kg. in form of muriate	2, 475	15.51	384.2

The muriate applied contained 47 per cent chlorin. The results show that the muriate and sulphate were equally effective on beets under the conditions of these experiments, viz, on a light soil poor in potash and phosphoric acid, but rich in lime and nitrogen. This is contrary to general opinion, but the author believes that where data pointing in the opposite direction have been obtained, as for example in the series of experiments conducted by Petermann at Gembloux, Belgium, during 1883–'84, 1887, and 1888–'89, the results obtained with different forms of potassic fertilizers are either within the limits of experimental

error, or the soil experimented with contained a sufficiency of potash and did not therefore respond to applications of potassic fertilizers.

Experiments with phosphatic fertilizers for sugar beets grown in marsh soil were begun in 1894, Thomas slag and superphosphate being compared. The former produced a heavier yield of sugar than the latter. The experiments were repeated on a larger scale during 1895, and in 3 different series, as in case of the potash experiments already described. Applications of nitrogen and potash were added in all cases at the rate per acre of 178.2 lbs. of potash (as sulphate), and 21.3 lbs. of nitrogen (as nitrate of soda); in addition the quantities of fertilizers given in the table were applied. The results were as follows:

Phosphoric acid experiments with sugar beets.

No. of trials.	Phosphoric acid (P_2O_5) applied per hectare.	Average weight of beets.	Sugar content of beets.	
	Zinc boxes, 0.3 square meter surface, 6 beets:	*Grams.*	*Per cent.*	*Grams.*
6	75 to 100 kg. as superphosphate	3,989	13.80	550.5
6	150 to 200 kg. as Thomas slag	3,692	15.30	561.9
	Glass cylinders, 572 sq. cm. surface, 1 beet in each:			
6	None	2,667	14.92	397.9
18	50 to 100 kg. as superphosphate	3,298	14.99	494.4
18	100 to 200 kg. as Thomas slag	3,348	15.28	511.5
	Cement-lined boxes, 1 square meter surface, 25 beets:			
1	None	4,925	12.92	636.3
2	50 to 100 kg. as superphosphate	6,582	13.99	920.6
2	100 to 200 kg. as Thomas slag	6,542	14.66	959.2
	Zinc boxes, 0.3 square meter surface, 6 beets in each:			
5	None	2,014	15.78	317.8
15	50 to 100 kg. as superphosphate	2,978	13.44	400.1
16	100 to 200 kg. as Thomas slag	2,724	15.53	423.0

The Thomas slag produced beets uniformly richer in sugar and a heavier yield of sugar than the superphosphate. The author states that experiments have shown the following fertilizer to be required for marshy soils in order to produce beets of equally good quality as those grown on stiff soils, viz, 300 kg. potash (K_2O) per hectare (in the form of 600 kg. (1,320 lbs.) of 80 per cent muriate of potash), and 150 kg. phosphoric acid (P_2O_5) per hectare (in the form of 900 kg. (1,980 lbs.) of Thomas slag of a high citrate solubility), the quantities given corresponding to 267.3 lbs. of K_2O and 133.7 lbs. of P_2O_5 per acre.

Experiments with Imperial barley.—Barley grown in a rich humus soil in laboratory experiments was found to vary considerably in its protein content under the influence of different fertilizers, and the subject was therefore taken up for systematic study according to a plan similar to that followed in the preceding trials. Two series of phosphoric acid experiments and one series of potash experiments were conducted.

The fertilizers applied and the results obtained were as shown in the following table:

Fertilizer experiments with barley on marsh soils.

Experiments with phosphoric acid.			Experiments with potash.		
No. of trials.	Phosphoric acid (P_2O_5) applied per hectare.	Protein in dry matter of grain.	No. of trials.	Potash (K_2O) applied per hectare.	Protein in dry matter of grain.
	In zinc boxes, 0.3 square meter surface:[1]	*Per cent.*		In zinc boxes, 0.3 square meter surface:[3]	*Per cent.*
1	None	17.12	2	None	18.12
2	150 kg. in form of Thomas slag	17.38	2	200 kg. in form of sulphate	18.62
2	200 kg. in form of Thomas slag	17.91	2	300 kg. in form of sulphate	17.34
2	75 kg. in form of superphosphate	16.65	2	200 kg. in form of muriate	15.31
2	100 kg. in form of superphosphate	15.96	2	300 kg. in form of muriate	15.93
	In cement-lined boxes, 1 square meter surface:[2]				
1	200 kg. in form of Thomas slag	17.31			
1	100 kg. in form of superphosphate	16.12			

[1] 200 kg. potash (sulphate) and 25 kg. N. (nitrate of soda) per hectare added in all cases.
[2] 100 kg. potash (sulphate) and 25 kg. N. (nitrate of soda) per hectare added in all cases.
[3] 200 kg. Thomas slag and 25 kg. N. (nitrate of soda) per hectare added in all cases.

The application of soluble phosphoric acid caused a depression of from 1 to 2 per cent in the protein content of the barley, compared with Thomas slag; the muriate of potash produced 2 to 3 per cent less protein in the grain crop than did the sulphate. A liberal supply of potash favors a high production of starch in plants, but as far as is known the muriate has not previously been shown superior to sulphate in this respect. The opposite is true in case of potatoes.

Experiments with fish guano.—One hundred parts of nitrogen in the form of fish (herring) guano had been found equivalent to 80 parts of nitric nitrogen in earlier laboratory culture experiments. A number of experiments were made in order to study the effect of a high fat content in the guano on the availability of the fertilizer. Common fish guano containing 13.3 per cent of fat, and guano freed from fat by extraction with ether, were compared, the oats experimented with being sown in glass cylinders of 491 sq. cm. surface area. The basal fertilization was 100 kg. potash (sulphate) and 200 kg. phosphoric acid (Thomas slag) per hectare, equivalent to 89.1 lbs. and 178.2 lbs. per acre, potash and phosphoric acid, respectively. The results were as follows:

Average results with ordinary and with fat-free fish guano on oats.

Nitrogen applied per hectare.	Yield of straw.	Yield of grain.	Increase in yield.
	Grams.	*Grams.*	*Grams.*
None	24.8	16.0	....
30 to 60 kg. in form of common fish guano	35.1	22.8	17.1
30 to 60 kg. in form of fat-free fish guano	37.3	25.2	21.7

—F. W. WOLL.

Provisions of the new fertilizer law of New York, L. L. VAN SLYKE (*New York State Sta. Bul. 103, n. ser., pp. 107-120*).—A law to regulate the sale of fertilizers in New York was passed in 1878, but no provisions were made for its execution.

"Another law was passed in 1890 and amended in 1894, but was so full of technical defects as to defeat all attempts at making prosecutions for violations. The present law became operative May 28, 1896.

"The present fertilizer law applies to 'any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds $10 per ton,' when such goods are sold, offered, or exposed for sale in this State.

"The new fertilizer law requires that there shall be printed on or affixed to each package of fertilizer, in a conspicuous place on the outside of the package, a plainly printed statement certifying: (1) the net weight; (2) the name, brand or trade mark; (3) the name and address of the manufacturer, and (4) the chemical composition expressed as follows: Per cent of nitrogen; per cent of available phosphoric acid, or, in case of undissolved bone, total phosphoric acid, and per cent of potash soluble in distilled water.

"Before any fertilizer can be legally sold, offered, or exposed for sale in this State the manufacturer or agent must file with the New York Agricultural Experiment Station, at Geneva, a statement like that provided for on packages, and also an additional statement in January of every year.

"When fertilizers contain leather or similar inert products the fact must be explicitly and conspicuously stated on each package."

A brief statement of the work accomplished by the station in inspection of fertilizers is added.

Since July, 1890, there have been collected and analyzed about 2,700 samples of commercial fertilizers manufactured by over 120 firms, nearly one-half of whom reside in other States.

The maintenance of soil fertility: Commercial fertilizers, F. W. WOLL (*Wisconsin Sta. Bul. 49, pp. 32*).—This is the first bulletin issued in accordance with the provisions of the Wisconsin fertilizer law passed in 1895, and gives the results of 10 analyses of fertilizers licensed for sale in the State during the current calendar year.

"It has been considered desirable, in addition, to include in the bulletin such general information on the subject of fertilizers and their application as will be helpful to the farmers of our State and aid them to a more thorough understanding of the problems connected with the maintenance of the fertility of their land."

The topics discussed are the nature and source of the different fertilizing ingredients; the fertilizing constituents of feeding stuffs and farm products; amounts of fertilizing constituents removed from the soil by different crops; the nature, management, and use of barnyard manure; green manuring; and the composition, valuation, and use of commercial fertilizers. The text of the State fertilizer law is also given.

Composition of commercial fertilizers, H. B. MCDONNELL ET AL. (*Maryland Sta. Bul. 37, pp. 52*).—Tabulated analyses and valuations of 439 fertilizers inspected September, 1895, to January, 1896, with a list of fertilizers licensed for sale in Maryland for the year ending January 31, 1896, and a schedule of trade values of fertilizing materials.

FIELD CROPS.

Experiments with corn, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 56, pp. 149–160*).

Synopsis.—Planting May 2, cultivating twice in a season, listing accompanied with deep culture, subsoiling 6 months or longer before planting, and planting late varieties gave best results.

Of 7 plantings on twentieth-acre plats at intervals of 1 week from April 18 to May 30, the best total yield was given by the planting of May 2. On 30 plats the cultivation varied from as often as 3 times a week to as seldom as once in 4 weeks. The results were contradictory, the averages for 3 years giving the best yields on plats cultivated once a week and once in 3 weeks. Two cultivations in a season gave better returns than 4 or 6. On the average for 3 years listed corn given deep culture gave best returns, followed by surface planted with deep culture.

Three eighth-acre plats were subsoiled, one in the spring and one in the fall of 1894, and one in the spring of 1895. The returns from the first two were greater and from the last one less than the yield of the check plats.

In a trial of butt, middle, and tip kernels for seed the results were contradictory.

A list is given of 28 varieties tested. In a comparison of red Kafir corn with Indian corn 6 plats were used, 2 for each variety. The red Kafir corn yielded nearly twice as much grain as the most prolific Indian corn.

In a comparison of early, medium, and late varieties, the late variety gave the best yield and the early one the poorest.

Field experiments with corn, H. J. WATERS and C. M. CONNER (*Missouri Sta. Bul. 32, pp. 32*).—This is a continuation of work reported in Bulletin 14 of the station (E. S. R., 3, p. 27).

Variety test (pp. 7–12).—In 1895 56 varieties were grown and the yields are tabulated. Of the dent varieties the highest average yield for 3 years was produced by Golden Beauty, 57.4 bu. per acre, followed by Leaming, Piasa King, Saint Charles White, and Chester County Mammoth.

Fertilizer test (pp. 13–17).—In 1891, as in 1889, applications were made at a uniform rate of 10 tons of barnyard manure per acre, fermented and unfermented, solid horse and cattle manure alone, and solid and liquid manure combined. These were applied both on the surface and plowed under. The tabulated data cover 3 years. The authors state that from the land where fresh barnyard manure was applied twice in 3 years an average increase in yield was obtained of 36.6 per cent. From the combined solid and liquid manures larger yields were obtained than from solid manure alone. Horse manure produced larger yields than cattle manure. Plowing manure under was better than applying it on the surface.

Preparation for planting (pp. 17–20).—In a test of thorough, partial, and no plowing the yields for 3 years increased with the thoroughness of preparation of the soil. Harrowing with the disc or spring-tooth harrow, instead of plowing, was unsatisfactory. The yields from plowing $4\frac{1}{2}$ in. deep were better than from 9 in. deep. Subsoiling showed no gain for the 3 years in yield of ruta-bagas, corn, or sugar beets.

Rate of seeding (pp. 22–24).—Tabulated data for 3 years are given. At a distance of 45 in. in 45-inch rows the total yield increased as the number of stalks in the hill increased, but there was an increased proportion of unmerchantable ears. The authors found that with a stand of 85 per cent it was unprofitable for the single season's trial to replant the missing hills.

Cultivation (pp. 25–27).—In deep *vs.* shallow culture the better yields were obtained from the latter.

Tile drainage (pp. 27, 28).—Tile drainage on upland clay with fair surface drainage has been for 3 years unprofitable with corn, mangel wurzels, and sugar beets. Weekly moisture determinations indicated slight differences in the water content of the drained and undrained soil from April to October.

Yields and time of ripening of five different varieties of maize, SAMEK (*Tirol. landw. Blätter, 15 (1896), No. 9, p. 85*).—Two foreign and 3 native varieties of maize were compared as to yield and time of ripening. The very tenacious soil received an application of barnyard manure and on May 10 was planted to maize at distances of 40 cm. in 67 cm. rows.

The yields are tabulated. The periods of ripening extended from August 21 with Szekler to October 19 with White Lanaer, the duration of growth thus varying from 98 to 150 days. The early or foreign sorts suffered more from insect attacks than the native or late sorts. The highest yield was given by White Lanaer 50.22 bu. per acre, followed by a native light yellow sort 44.89 bu., Cinquantino 36.16 bu., Polish maize 32.72 bu., and Szekler 23.25 bu. The last two were the foreign varieties and had the shortest periods of growth. Had they been planted more closely they would probably have given a larger yield. They are well adapted to northern climates with shorter seasons or to double cropping in warm regions.

Grain and forage crops, J. H. SHEPPERD (*North Dakota Sta. Bul. 23, pp. 31–54*).—Previous work in this line was published in Bulletins 10 and 11 of the station (E. S. R., 5, pp. 176, 678). Tabulated yields are given of 36 varieties of spring wheat, 39 of oats, 20 of barley, 23 of corn, and 38 of potatoes. The Tartarian and Race Horse varieties of oats were comparatively rust proof.

The rotation plats were reduced in size in 1894 from 1 acre to $\frac{1}{5}$ acre and the number increased to 35. Compared with the yield of wheat under continuous cropping, the effect of the rotation during the first year was to increase the yield after summer fallow 63 per cent;

after the cultivated crops 75½ per cent; after millet 41½ per cent; and after timothy and clover 33 per cent.

After sowing 6 different mixtures of oats and peas for forage the author recommends per acre ¾ bushel of oats to 2 of peas. Directions are given for the culture of Dwarf Essex rape. After tests of Kafir corn, millo maize, durra, and Jerusalem corn during 2 years the author recommends growing Indian corn instead.

Kafir corn, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 56, pp. 161-168*).—The authors review previous work of the station with Kafir corn. The largest yield so far obtained was in 1891 with red Kafir corn, 98.7 bu. of seed, and 12.29 tons of fodder per acre.

Planting at different distances (pp. 162, 163).—On 48 trial plats the rows varied from 16 to 32 in. and the plants from 4 to 8 in. in the row. The largest yield of grain was obtained with plants 4 in. apart in 32-inch rows. The authors state that experiments have shown that when corn and nearly all other crops are complete failures, Kafir corn will yield a fair crop of forage.

Varieties (pp. 164, 165).—Red, white, and black-hulled white Kafir corn (African millet) are described. Red is preferred to white; it grows 6 to 9 in. taller, ripens earlier, does not shell in handling, has a juicier stalk, and the head always pushes clear of the upper sheath. The seed of white Kafir corn is liked better by stock. The black-hulled white has been grown the past season only. It is very promising, and may surpass the red.

Culture (pp. 167, 168).—Full directions for the culture of Kafir corn are given. It is adapted to all soils, and to regions too dry for corn.

The manuring of irrigated meadows, STREKER (*Sächs. landw. Ztschr., 1896, No. 23, pp. 267-269*).—In 1894 on land which had been used for meadow 9 years in the district of Vaucluse, France, 5 plats were laid out containing 158 square rods each. To 1 plat was applied superphosphate, to another urine, and to another barnyard manure, to another nitrate of soda, muriate of potash, and phosphate of lime, and 1 plat received no fertilizer. This experiment was repeated in 1895. The yields for the plats where phosphoric acid or a complete commercial fertilizer had been applied were largely in excess of the unmanured plats. The barnyard manure and the urine were used either at a loss or at a very small profit.

Experiments in manuring meadows (*Selskoe Khozyaistvo i Lyesovodstvo, 1895, No. 153, pp. 229, 230*).—The agricultural experiment station of the Polytechnic School at Riga carried out a series of experiments for the purpose of investigating the influence of artificial manures on the improvement of meadows. On the Ebelshof estate 16 plats, 3,920 sq. ft. each, were laid out. Two plats were manured with Thomas slag, 2 with bone meal, 2 with kainit, and 2 with a mixture of Thomas slag and kainit. There were 8 check plats. Twenty-four pounds of fertilizer was applied to each of the 8 plats in the fall of 1890, 48 lbs.

in the falls of 1891 and 1892, and 10 lbs. of nitrate of soda in the spring of 1894. Tabulated data of the yields are given for 5 years.

The plats receiving the mixture of Thomas slag and kainit gave the largest yields, followed by the potash plats. The residual effect was greatest on those plats receiving the mixture, followed by those on which Thomas slag was used.

Potatoes, L. R. TAFT (*Michigan Sta. Bul. 131, pp. 3–11*).—This is a continuation of previous work reported in Bulletin 108 of the station (E. S. R., 6, p. 208).

Test of varieties (pp. 3–9).—Ninety varieties were tested, 2 lbs. of seed of each variety being planted June 8. July 2 and twice later at intervals of 3 weeks the plats were irrigated. The yields are tabulated, and descriptive notes given on a number of varieties. The following varieties are recommended: Early—Early Peachblow, Early Walton, Freeman, Milwaukee, North Pole, Clay Rose, Victor Rose, and Pearl of Savoy; medium to late—Summit, American Wonder, Irish Daisy, Park Region, O. K. Mammoth, On Top, Prize Taker, and others.

Fertilizer test (pp. 10, 11).—On 17 eighth-acre plats on a light sandy loam on which rye, buckwheat, and similar crops had been grown for several years previous, were applied muriate and sulphate of potash, ground bone, boneblack, nitrate of soda, wood ashes, and stable manure, either alone or in various combinations. The Rural New Yorker No. 2 variety of potatoes was planted at distances of 3 by 3 ft. An unmanured strip of 3 ft. was left between each plat and the adjacent one. A diagram is given showing the arrangement of plats, kinds and amounts of fertilizers applied, and the yields per acre obtained. The largest yield was obtained where 24 loads of stable manure per acre were applied, a gain of nearly 70 bu. per acre over an adjacent unmanured plat. The author states that the average gain from the use of a full application of fertilizers was 80 bu. per acre. There was a gain of about 8 bu. per acre in favor of sulphate of potash over muriate of potash.

Potato experiments, R. H. MILLER and E. H. BRINKLEY (*Maryland Sta. Bul. 38, pp. 55–63*).—This is a continuation of work reported in Bulletin 31 of the station (E. S. R., 6, p. 983), and consists of tests of varieties, experiments with fertilizers, green manuring, distance, methods of cultivation, amount of seed, and spraying. The yield where crimson clover was plowed under showed an increase of 34.4 bu. per acre, or 50 per cent. With distances 30 by 14 in. there was an average gain for 2 years of 19 bu. per acre over 36 by 12 in. Practically the same results were given by ridge and level culture and by deep and shallow cultivation. The yields showed a gain of 86 per cent where the plants were sprayed with Bordeaux mixture.

Inquiry into the principles of potato growing, and tests of varieties, P. SCHWEITZER (*Missouri Sta. Bul. 33, pp. 24*).—Inconclusive experiments were made in 1891. In 1894, on well-prepared land, plowed and subsoiled 18 in. deep, and to which 1,300 lbs. per acre of a fertilizer

consisting of nitrate of soda, muriate of potash, salt, gypsum, and dissolved bone were added, potatoes were planted 12 in. apart in 1 and 2 eye pieces, quarters, halves, and wholes for each of 12 varieties.

Early Vermont is reported as the best and Burbank the poorest variety. Whole tubers gave the highest yields.

In 1895 the Early Maine variety was planted on well-prepared soil in 44-inch rows. The fertilizer, where used, consisted of equal parts of sulphate of potash and superphosphate. For given areas the seed planted, whether pieces or whole tubers, was at the same distance apart in the row. The yields for the different amount of seed are tabulated. The author concludes that 900 lbs. per acre was the limit of profitable application of fertilizers, and that "it makes no difference whatever whether potatoes are planted whole or in pieces. . . . The result depends entirely upon the fertility of the soil and the character of the season, both of which determine the stand of the crop as a whole, as also the productiveness of each individual plant."

The yields of the 76 varieties tested are tabulated, 18 giving a yield of over 400 bu. per acre, 3 of over 500 bu., and Mills Prize nearly 600 bu. From the data the author concludes that "the size of the seed potato has nothing to do with the greater or less number of small potatoes. It is simply a question of the vigor of the plants, the richness of the soil, and the proper condition of the season."

A test of northern and home grown seed potatoes, C. O. FLAGG, J. D. TOWAR, and G. M. TUCKER (*Rhode Island Sta. Bul. 36, pp. 3–8*).—Fourteen varieties of potatoes, of Maine-grown and home-grown seed, were tested during 2 years on a sandy loam soil, manured with commercial fertilizers applied on a clover sod. Ten pounds of seed of each variety was used, cut in one case to 150 pieces, in the other to 2-eye sets, and planted 16 in. apart in the row. The vines were sprayed for potato blight. The yields are tabulated.

In their summary the authors say that of merchantable potatoes the northern-grown seed tubers produced a greater percentage in 11 out of 14 varieties, and a greater yield in 9 out of 14 varieties, the average increase being 17.04 bu. per acre; the home-grown tubers gave a greater yield in 5 out of 14 varieties, the average increase being 20.94 bu. per acre.

Early potatoes, C. O. FLAGG and G. M. TUCKER (*Rhode Island Sta. Bul. 36, pp. 9–27, figs. 13*).—The methods of hastening maturity by starting the tubers in pots under glass, and sprouting the thickly planted sets in a cold frame are described, and under the second method the experience of a Rhode Island planter is given. In the second method 12 sash 3 by 6 ft. are required for each acre. The cuttings of seed tubers are put into the prepared and fertilized soil of a cold frame from the 15th to the 20th of March, 3 pecks of tubers for each sash. When about to break ground the sets are lifted from their position by a manure fork, separated by hand, and placed 12 in. apart in 30 to 32 inch rows. The average yield has been 95 barrels per acre.

Budding (pp. 12–19).—Seed tubers about the size of hens' eggs placed stem end down on racks held in tiers in a framework are kept in a moderately warm (60 to 75° F.) and fairly lighted room for 4 to 6 weeks. The racks are figured and described. Thick, firm buds ½ to 1 in. long and ¼ to ⅜ in. in diameter will form which, when ready for planting, may be kept uninjured for days or weeks by lowering the temperature.

On March 20, 2 bu. of the Early Rose variety, each containing 311 potatoes of an average weight of about 3 oz., were taken from the bin; one bushel was kept in a bag in a cold cellar; the other was placed in a tray under favorable conditions for budding. May 1, on a light, sandy loam, manured with commercial fertilizers, ¾ applied broadcast and ¼ in the drill, the potatoes were planted in 8 rows at distances of 15 in. between sets. Each tuber was cut in two before planting.

On July 29, 10 ft. of each row was harvested, and on August 20 the remainder of the crop. The following table contains the yield per acre, the gain from the budding method and the increased growth between the two dates of harvesting:

Yield per acre of potatoes from seed tubers budded and not budded.

	Date harvested.	Large tubers.	Small tubers.	Total.	Gain by budding.	Increase from further growth.
		Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Budded	July 29	97.96	53.23	151.19	32.31	....
Not budded	...do ...	76.10	42.78	118.88	....	....
Budded	Aug. 20	135.47	55.51	190.98	54.63	33.79
Not budded	...do ...	94.45	41.90	136.35	....	17.47

Notes are given on potato culture on the island of Jersey. The authors state that where large seed tubers are used sprouting is preferable to budding.

Potatoes, fertilizer experiments, W. J. GREEN and H. O. MCFADDEN (*Ohio Sta. Bul. 65, pp. 154–159*).—The trial plats are of $\frac{1}{10}$ acre at the central station and $\frac{1}{20}$ acre at the substations. Superphosphate, muriate of potash, nitrate of soda, bran, linseed meal, dried blood, sulphate of ammonia, bone meal, acid phosphate, basic slag, and barnyard manure, alone or combined in various proportions, were applied on 18 plats; of these, 8 plats received the same quantity of nitrogen, phosphoric acid, and potash, but in different forms. Thirteen plats were without fertilizers.

The yields are tabulated. In conclusion the authors say:

"In the use of fertilizers the lowest cost per bushel of increase in crop has been attained in the use of superphosphate alone, but the greatest gain per acre has been with 1,100 lbs. per acre of fertilizer containing phosphoric acid, nitrogen, and potash.

"Muriate of potash and nitrate of soda when used alone have not given a profitable increase, but have proved beneficial in connection with superphosphate.

"Phosphoric acid seems to have been the controlling element in an increase in the potato crop in all of our experiments."

Potatoes, variety tests, S. B. GREEN (*Minnesota Sta. Bul. 45, pp. 299–307, fig. 1*).—Notes and tabulated data are given on 45 varieties of potatoes tested at the station farm, 23 varieties in Lyon County, and 16 varieties in McLeod County. Among the largest yields per acre are the following: At the station farm, Rural New Yorker No. 2, 388 bu.; Lee Favorite, 349 bu.; Early Everitt, 343 bu.; Early Oxford, 328 bu., and Irish Cobbler, 325 bu.; in Lyon County, Worlds Fair, 551 bu.; American Wonder, 528 bu.; Irish Daisy, 510 bu.; Early Oxford, 470 bu., and Pearl of Savoy, 467 bu. In McLeod County the highest yield was given by Summit, 227 bu.

Notes are given on 17 of the newer varieties of potatoes grown on the station farm in 1894.

Variety trials with potatoes, W. J. GREEN and H. O. MCFADDEN (*Ohio Sta. Bul. 65, pp. 141–154*).—The authors begin with a discussion of the difficulties and value of variety tests of potatoes. May 16, 17, and 19, 1895, on duplicate sixtieth-acre plats on a clay loam soil, 71 varieties of potatoes were planted in 2 eye pieces 16 in. apart in 33½-inch rows. The yields are tabulated for 1894 and 1895. Sixteen varieties are mentioned as above the average in yield, American Wonder, Columbus, Carman No. 1, Early Northern, Forest Rose, and Irish Daisy leading.

Tabulated yields are given of a test of varieties at two substations and at the central station. The results were unsatisfactory. A comparison was also made between northern seed and second-crop southern, with inconclusive results.

Descriptive notes are given on 42 varieties.

Potato culture, results of 1894 and 1895, A. GIRARD (*Prog. Agr. et Vit., 13 (1895), No. 20, pp. 550–556*).—An account of coöperative experiments in potato culture participated in by 88 experimenters in 1894 and by 68 in 1895, under direction of the author. The plowing was done at depths of 7 to 8 in., and in some cases as deep as 11½ to 15 in. Both barnyard manure and commercial fertilizers were applied liberally, in most cases at the time of planting. Whole tubers were used almost exclusively, planted 19½ by 23.4 in.

The largest yield reported was in 1894, 623.2 bu. per acre; the yield on the same farm in 1895 was 235 bu. per acre, the difference being due to drought. In 1894 11 farms, and in 1895 7 farms, averaged over 5194. bu. per acre. The percentage of starch was lower in the potatoes grown during the wet summer of 1894 than during the dry summer of 1895.

Culture of the potato in Algeria, H. HITIER (*Jour. Agr. Prat., 60 (1896), I, No. 24, pp. 872, 873*).—The difficulty with potato culture in Algeria, according to the author, is that the seed has to be renewed every year from France or other foreign country. Richter Imperator, however, has been cultivated there successfully for 6 years. Two crops of potatoes can be raised every year in the littoral region, the

second giving an inferior yield. It is proposed to try raising the variety mentioned in the oases of the Sahara next year.

Experiments in the culture of the sugar beet in Nebraska, H. H. NICHOLSON and T. L. LYON (*Nebraska Sta. Bul. 44, pp. 109–125, map 1, charts 2*).—Previous work in this line was reported in Bulletin 36 of the station (E. S. R., 6, p. 209). A description of the method of culture, determinations of sugar content in samples of beets grown in different parts of the State, and data on the temperature and rainfall for different sections of the State are given. Experiments were made on the effect of certain fertilizers, as compared with no fertilization, value of large and small seed and heavy and light seed, tests of varieties, and analyses of the by-products of a beet sugar factory.

The authors consider the use of potash fertilizers unprofitable and recommend seed of more than average size. Five varieties were tested, and Kleinwanzleben, Vilmorin, Lemaire, and Desprez are recommended. Food ingredients of pulp and sugar beets, and fertilizer ingredients of dried lime cake are given.

Tobacco, yellow leaf and cigar varieties, W. C. STUBBS, J. G. LEE, and D. N. BARROW (*Louisiana Stas. Bul. 41, 2d ser., pp. 1472–1499*).—Previous work in this line was published in Bulletin 33 of the stations (E. S. R., 7, p. 29). This bulletin is a record of fertilizer and variety experiments at the North Louisiana Station at Calhoun with cigar and bright leaf tobaccos, and at the State Station at Baton Rouge with cigar tobaccos.

At Calhoun 13 varieties of cigar tobaccos were tested, with and without fertilizers, on a red sandy soil, the yields of cured tobacco averaging 630 and 558 lbs. per acre, respectively.

Similar tests were made with bright long-leaf tobacco on "lighter mulatto sandy soil" with average yields of 788 lbs. with and 505 lbs. without fertilizers.

Experiments with different amounts and combinations of fertilizers indicated that nitrogen is needed to grow tobacco successfully on the soils tested.

The conclusions for Calhoun are in general as follows:

"Our soils are not well adapted to cigar tobacco.

"Hester, Ragland Improved Yellow Oronoko, Conquerer, Long Leaf Gooch, and Hyco are the best varieties of the bright-leaf type.

"The old pine fields of North Louisiana can be reclaimed in producing these types of tobacco, and that with liberal fertilizing good profits are sure."

At Baton Rouge experiments were made on the bluff soils. Nineteen varieties of cigar tobacco were tested with unsatisfactory results.

In a fertilizer test 3 varieties were grown, and nitrogen, phosphoric acid, and potash in various forms, combinations, and amounts were applied. The author states that fertilizers have increased the quantity and quality of tobacco.

Three methods of curing were tested—air curing of whole plant, air curing of leaves placed separately on Snow laths, and curing the leaves in the Snow barn by artificial heat.

Brief directions for harvesting, stripping, and assorting, and a description of the barn are given.

Types of tobacco and their analyses, F. B. CARPENTER (*North Carolina Sta. Bul. 122, pp. 331–366*).—Tabulated analyses are given showing the nicotin, nitrogen as nitrate, and total nitrogen in different parts of the plant at different stages of growth, and the nicotin, ether extract, albuminoids, nitric nitrogen, ammonia, cellulose, ash, potash, lime, and chlorin in 29 samples of leaves of typical tobaccos, exclusive of midrib, and of 29 samples of midrib. The following topics are also treated of: Production of tobacco in the United States, varieties and classification of tobaccos, tobacco soils, fertilizers, development of nicotin in the tobacco plant, descriptions of typical tobaccos, and relation between chemical composition and burning quality.

The nicotin at maturity is found mainly in the leaves. The percentage found in the whole leaf ranges in the tobacco grown in the United States from 1.96 to 5.53. A coarse rank growth is associated with a comparatively large amount of nicotin.

The author states that the burning qualities are more largely dependent upon the composition of the ash than upon the extent of fermentation; also that in these tests the best burning tobaccos were accompanied by a high percentage of ash constituents, particularly lime, and by potash in proper combination.

Among his general observations the author says:

"The percentage of nicotin and albuminoids is materially increased by the use of large quantities of nitrogenous manures.

"A large percentage of nitrogen in the form of albuminoids is usually accompanied by a large nicotin content.

"The percentage of nicotin in the leaf is largest just as the leaf reaches maturity, but the amount is materially reduced by the various processes of fermentation to which the product is subjected before manufacture.

"While nicotin is the active principle of tobacco and is desirable to a certain extent, it was found that the high-priced varieties contained a relatively small percentage.

"The nitric nitrogen is chiefly confined to the stems, and is not present in the leaf in appreciable amounts, except when large quantities of nitrogenous fertilizers are present in the soil. Its presence as such seems to be of no special importance.

"Relatively larger quantities of potash than of any other fertilizer constituent seem to be required for the growth and production of a good quality of smoking tobacco."

Test of fertilizers on wheat, D. O. NOURSE (*Virginia Sta. Bul. 47, pp. 141–144*).—This is a continuation of work published in Bulletin 29 of the station (E. S. R., 5, p. 495). Nitrogen, phosphoric acid, and potash were applied singly and in combinations of 2 and 3. The yields are tabulated.

The author concludes that phosphoric acid gives an increase in proportion to the quantity applied up to 213¾ lbs. per acre, and nitrogen and potash seem to increase the product only when both are used in combination with phosphoric acid.

Suggestions are given relative to conducting plat experiments on farms.

Variety tests of wheat, W. M. HAYS (*Minnesota Sta. Bul. 46, pp. 342-350*).—Previous work in this line was published in Bulletin 40 of the station (E. S. R., 7, p. 118). The yields and other data are tabulated for 22 varieties of spring wheat selected from 250 varieties previously grown at the station and on a private farm. The best 5 varieties, an average of 5 years, were Bolton Blue Stem, Glyndon No. 711, White Russian, Blount Hybrid No. 15, and Power Fife.

Original seed vs. seed improved by selection (pp. 346-348).—Tabulated yields of grain and straw, and other data, are given for 44 samples of wheat, comparing original seed with seed improved by selection. The yield of Haynes Blue Stem was 21.6 bu. per acre. The average yield of 8 improved varieties derived from it was 31.9 bu., an increase of over 10 bu. per acre. The yield of Power Fife was 26.3 bu., and the average yield of 7 varieties derived from it was 35.4 bu., a gain of 9.1 bu. The average yield of 5 of Saunders' crossbred varieties was 38.6 bu. The large yields were due to especially favorable conditions.

Crossed wheats (pp. 348-350).—The method followed at the station for crossing wheats is described, and tabulated data are given for 18 crossbred varieties.

Tillage experiments, W. M. HAYS (*Minnesota Sta. Bul. 46, pp. 384-389*).—These trials were made in the southwestern part of the State on a farm near Camden, on 88 tenth-acre plats. An elaborate series of experiments was planned for the purpose of studying the best method of conserving soil moisture. On a medium heavy soil of mixed clay, sand, and gravel, 6 plats were plowed in the fall and 6 in the spring at depths of 3½, 5½, and 7½ in., and sown to wheat with the press and chain drills on duplicate plats. In all cases the fall-plowed land yielded several bushels more per acre.

In a comparison of land manured with barnyard manure, rotted and fresh, with unmanured land, in 5 cases out of 7 the unmanured plat gave largest returns of wheat per acre. Subsoiling for wheat was unprofitable. A comparative trial of shoe-chain and shoe-press drills and broadcast seeders favored the shoe-press drill. Wheat sown in drills 21 and 28 in. apart, and cultivated, yielded less than that sown in the ordinary way. No differences were shown in plowing for wheat 3½, 5½, and 7½ in. deep. Burning the stubble and preparing the seed bed with a disk harrow gave as good results as plowing.

Silage and silos, W. P. WHEELER (*New York State Sta. Bul. 102, n. ser., pp. 89-105, figs. 4*).—A popular bulletin embracing the following topics: The comparative advantages of preserving fodder in the silo and by dry curing, silage and roots, losses in the silo, variety and maturity of silage crops, silage for different stock, silage and milk, silo construction, rectangular silos, round silo, freezing and ventilation, cost, preservation of the silo, filling the silo, and harvesting the crop.

The author considers Indian corn the best plant for silage, that it is cheaper and generally more efficient than roots, and equal in feeding

value to the best dried corn fodder. The largest growing variety that is reasonably sure to ripen before frost is the best one for the silo—to be cut after the grain is glazed.

The silo should have rigid, air-tight walls, and a depth of 30 ft. or more, with an allowance of not more than 5 sq. ft. of feeding surface per cow.

Cross rotation experiments, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 369–373*).—In 1894, on 6 series of 12 plats each, were planted 6 crops, 1 to each series. They were field peas, mangel-wurzels, potatoes, flax, wheat, and corn. In 1895 the same crops were planted across the series of plats, giving for each crop duplicate plats separated by 5 others. A diagram is given of the plats, showing also the yields. Mangel-wurzels gave the best yield after peas; wheat and flax after potatoes; and corn, potatoes, and peas after corn. The author states that the hoed crops—corn, potatoes, and mangels—had an especially good effect in preparing the land for other crops, while the reverse was true with flax, wheat, and even field peas.

On recent breeding of cultivated agricultural plants (*Braunschw. landw. Ztg., 64 (1896), No. 34, pp. 139, 140*).—The author describes his experiences in increasing the productive capacity of wheat by improved methods of culture and by cross fertilization. In the latter case he used a square-head variety as the staminate parent for crossing with the ordinary varieties of German wheat.

Variety tests of barley, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 350, 351*).—The yields for 2 years of grain and straw and other data are tabulated for 34 varieties. French Chevalier gave the highest yield of the named varieties, followed by Odessa, Champion of Vermont, Highland Chief, Black Hulless, and Salzer.

Corn experiments, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 331–342*).—Tabulated data are given of a test at the station and on a farm elsewhere of 18 named varieties of corn, and of 22 samples received from farmers, with general remarks on dent, flint, and sweet varieties. A statement is made in regard to the method used at the station for improving varieties of corn. Drying seed corn by artificial heat is recommended. In a trial on 8 plats of depths of plowing and subsoiling the best yields were on the plats plowed 4 in. deep.

Variety tests of oats, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 352, 353*).—The yields for 2 years of grain and straw and other data are tabulated for 63 varieties. The largest yields at the station farm in 1895 were given by Giant Side, Wide Awake, Haggett White, Early Swedish, White Russian, and Improved Ligowo.

Variety tests of field peas, W. M. Hays (*Minnesota Sta. Bul. 46, p. 354*).—Yields of grain and other data are tabulated for a field test of 33 varieties of peas grown at the station and on a private farm. The largest yield was given by White Canada Field, 20.3 bu., followed by Alpha, Blue Prussian, Crown, and Green Canada Field.

Influence of manure on the starch content of potatoes, Comon (*Prog. Agr. et Vit., 26 (1896), No. 37, pp. 310–312*).

Variety tests of rape, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 360, 361*).—The period of growth and the yield of green forage per acre are given for 11 varieties of rape, including 4 from Japan. Dwarf Essex gave the largest yield, 18.3 tons per acre.

Field root crops, W. M. Hays (*Minnesota Sta. Bul. 46, pp. 356–360*).—The period of growth and the yield per acre are tabulated for 12 varieties of mangels, 2 of sugar beets, 8 of turnips, 4 of ruta-bagas, and 3 of carrots.

Planted at depths of ½, 1, and 1½ in., mangel, ruta-baga, and carrot seed gave the largest yields with the shallowest planting, and turnips at 1 and 1½ in. deep. With

plants 4 in. apart in 18, 24, 30, and 36 in. rows, the turnips yielded best at 18 in., ruta-bagas at 24 in., and mangels at 30 in.

On the application of kainit to rye, A. EMMERLING (*Landw. Wochenbl. Schles. Holst., 46 (1896), No. 33, pp. 471-473*).—The author thinks that the application of kainit to rye on sandy soil should be made under the most favorable conditions, *e. g.*, after green manuring and when serradella or some other clovers are sown with the rye. At the present low prices the use of kainit on rye does not promise much in the way of profit.

The relation of bacteria to tobacco culture and manufacture, J. BEHRENS (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 17, pp. 540-545*).—A compilation is given, together with an extensive bibliography of our present knowledge of the subject.

Wheat, cutting at different dates, R. H. MCDOWELL (*Nevada Sta. Bul. 30, pp. 7*).—Fourteen cuttings in 1894 and 13 in 1895 were made while the wheat kernels advanced from the milk stage to dead ripe. The yields per acre are tabulated, and the author states that they were calculated as follows: "The cutting that required the least number of kernels to weigh one-half ounce was taken as the one giving the best yield. In each case it was assumed that the maximum yield per acre was 40 bu." Analyses are given showing the albuminoids, crude fiber, and ash for each cutting. The author recommends cutting when the grain is "in stiff dough."

New cross-bred wheats, VILMORIN-ANDRIEUX (*Jour. Agr. Prat., 60 (1896), II, No. 38, pp. 424, 425, fig. 1*).—A description is given of a new variety, the "Briquet jaune," also of the "hybrid de Champlan," and of the "hybrid Gotellier."

Culture of wheat at the experiment station of Capelle, F. DESPREZ (*Jour. Agr. Prat., 60 (1896), II, No. 38, pp. 425-429*).—Cultural notes are given on the following varieties: Kaough-Chaaf, White Square Head Scheriff, White Head Cambridge, Standup, Lamed, Challenge, Blanzed Desprez, and Victoria.

Hairy vetch in southern France, C. TALLAVIGNES (*Prog. Agr. et Vit., 26 (1896), No. 33, pp. 182-184*).—Unfavorable report given.

HORTICULTURE.

Onion culture, R. L. WATTS (*U. S. Dept. Agr., Farmers' Bul. 39, pp. 30, figs. 3*).—This bulletin urges the importance of the onion crop in the United States and the necessity of improved culture. Light, well-drained, fertile soils are recommended, especially those well stocked with organic matter. Liberal fertilizing is recommended for onions, applications of nitrate of soda 200 to 400 lbs. in four equal dressings, kainit 800 to 1,000 lbs., and a few hundred pounds of bone meal per acre being suggested for this purpose.

American varieties are best adapted to most parts of the United States, and the following have proved most successful: Danvers, Extra Early Red, Egyptian, Red Globe, Yellow Globe, Potato Onion, Shallots, Silver Skin, Wethersfield, White Globe, and Yellow Strasburg. These varieties are described, as are also 16 foreign varieties, of which Prize-taker is the most desirable.

Starting the seed under glass and transplanting the young plants later to the field, is recommended, and directions are given for carrying it out, and also for cultivation, harvesting, and storage. Storing the crop in dry, cool apartments is preferred. In addition, the method of growing onions for seed is briefly mentioned, and remedies are given for the onion maggot (*Phorbia ceparum*) and onion smut (*Urocystis cepulæ*).

Tomatoes, S. B. GREEN (*Minnesota Sta. Bul. 45, pp. 313–320, figs. 2*).—This consists of variety tests and brief notes on forcing and spraying tomatoes. Tabulated data and descriptive notes are given for 46 varieties, indicating the yields and the ability of each variety to resist rot. In addition, an illustration, reduced from a photograph, is given of 50 varieties of tomatoes grown at the station in 1895. The largest yield was obtained from the variety Early Advance, Belmont ranking next. The largest percentage of good fruit (95) was produced by Landreth No. 1. The most rotten fruit was afforded by the varieties Longkeeper and Volunteer, each giving 50 per cent.

Tomatoes were forced in rich soil over well-rotted horse manure in a barrel, and trained up the south side of a building, with good results. Experiments conducted for 2 and 3 years past with potassium sulphid and Bordeaux mixture for the prevention of rot in tomatoes have given unsatisfactory results, and the best method of avoiding rot is believed to be the selection of resistant varieties and the use of uninfected land.

Much variation was found among different varieties in susceptibility to rot. Early tomatoes were, as a rule, found to be inferior in quality to later varieties. The varieties Acme, Dwarf Champion, and Beauty are generally recommended for commercial planting, with the use of Early Ruby, Maule Earliest, and Earliest of All in sections where the seasons are short.

Vegetables, L. C. CORBETT (*West Virginia Sta. Bul. 42, pp. 211–226, pl. 1, figs. 2*).—This bulletin comprises notes and tabulated data of 19 varieties of bush beans, 9 of pole beans, 36 of cabbage, 35 of peas, and 42 of tomatoes. The fruits of the different varieties of tomatoes are illustrated from a photograph. To test its value for preventing tomato rot a mulch of straw was applied to one plat of tomatoes, while two others received sprayings with Bordeaux mixture and no treatment, respectively. The plants treated with the straw mulch developed the least rot. The experiment is to be continued during succeeding years to test varying atmospheric conditions. A comparison of methods of training tomato plants showed that those plants supported on brush, over which they were allowed to fall at will, gave the greatest yield, while the earliest fruit was obtained from plants trained in a trellis made of barrel hoops fastened to stakes.

Vegetable tests, H. P. GLADDEN and U. P. HEDRICK (*Michigan Sta. Bul. 131, pp. 12–36*).—This consists of tabulated data and descriptive and brief cultural notes on 20 varieties of bush beans, 8 of pole beans, 5 of beets, 9 of celery, 12 of cucumbers, 8 of lettuce, 27 of radishes, 17 of squashes, 66 of tomatoes, and 60 of peas.

Twelve plats of tomatoes, each containing a square rod, were used to test the effect of various fertilizers. The variety employed was Ignotum, and 20 plants were set in each plat. The largest yield, 352¼ lbs., was obtained from a plat to which 3 lbs. of dissolved bone had been applied, but as the next largest yield, 309¾ lbs., was obtained from an unfertilized plat, the result is believed to be inconclusive.

In an experiment in irrigating 3 rows of tomatoes, each by a different method, the rows so treated gave a larger yield than check rows not supplied with water, but the best method of irrigation was not decided upon.

All the named varieties of peas offered by American seedsmen which had not been previously tried and discarded were grown, the objects being to determine the respective values of the varieties under the station conditions, to determine the duplicate and synonymous varieties, and to ascertain if any of the varieties could be further improved. It was found that the different varieties of peas were very liable to lose their original characteristics, especially in regard to the seed.

Dwarf apples, E. G. LODEMAN (*New York Cornell Sta. Bul. 116, pp. 317–345, figs. 5*).—This bulletin discusses the subject of dwarfing in general, with remarks upon the effect of checking the movement of sap in fruit trees. The circulation of the sap in fruit trees is popularly explained according to the principles of plant physiology, and the method of obtaining greater fruitfulness by means of partially girdling trees or encircling them with tightly constricting bands is discussed. The dwarfing of fruit trees is usually done by grafting a variety upon another of smaller habit and much slower growth. The belief that dwarf trees produce larger and handsomer fruit than standard trees is considered highly probable, although the matter has not been settled by experiment. Of all fruit trees, pears are most often dwarfed, followed closely by apples, although cherries and plums are also grown as dwarfs.

Apples are at present regularly dwarfed by grafting or budding the desired variety upon some small form of the common apple species, *Pyrus malus*. The forms usually employed are the Paradise and Doucin types of apple. These two stocks are described and the history of their use for dwarfing is given, together with a brief note on the Rennette apple, also used for this purpose. The Paradise apple is the earliest of these forms, having been known in France at the beginning of the Fifteenth century, and the Doucin was first brought to notice a century later. Dwarf apple stocks are propagated by means of suckers which are detached the first year and grafted or budded the second year with the desired variety. The dwarf apple trees should be thoroughly and persistently pruned from the time they are set, each year's growth being cut back one-half or two-thirds. By this means fruit spurs will be more freely produced and more evenly distributed over the trees and the dwarf habit maintained. The lowest branches should spring from the trunk at a height of from 10 to 18 in. from the ground. The tops should be pruned in the form of a broad vase, and summer pruning may be employed if the amount of fruit buds borne is considered too small.

Orchards of dwarf apple trees are recommended to be set with the trees 12 to 15 ft. apart where the soil is rich and the varieties vigorous.

Dwarf trees 10 to 15 years old average 3 to 4 pecks of apples annually, or 75 barrels of fruit from an acre of 300 trees. After the trees have passed their twentieth year they will bear from 2 to 4 bu. each. An annual yield of 125 barrels per acre from an orchard of 30-year-old trees is regarded as average. This yield is very favorable as compared with that of standard trees, which are estimated to give 135 barrels per acre from trees of the same age as the dwarfs. Tables are quoted comparing the actual yields from orchards of standard and dwarf apples in Denmark, where dwarf trees are more extensively grown. The Doucin stock shows a slightly greater fruitfulness than any other.

A list is included of the varieties considered to be best adapted for dwarfing, and a brief summary of the main points embodied in the bulletin is appended.

Evaporating apples, W. B. ALWOOD (*Virginia Sta. Bul. 48, pp. 15, dgm. 1, figs. 3*).—This bulletin advocates the drying of apples by the use of evaporating apparatus in place of the method of sun drying now employed throughout Virginia. It is stated that the apple production of the State is so large that the industry of evaporating apples can easily be made a profitable one. Figures are given comparing the relative results reached by the processes of sun drying and evaporating showing that while the cost of manufacturing is practically the same (about 3 cts. per pound of dried fruit) the evaporated fruit brings on an average 6 cts. per pound, while the sun-dried fruit averages $2\frac{1}{2}$ cts. per pound. It is believed that by obtaining the green fruit at the usual price of from 8 to 10 cts. per bushel, profitable returns can be had. A large percentage of the apples grown in Virginia are unmarketable, chiefly because of the bad selection of varieties planted by farmers. This inferior fruit can readily be utilized in evaporating establishments.

Descriptions, diagrams, and directions are given for the construction of evaporating plants, the drying being done either by heat from furnaces or by coils of steam pipes. Evaporators fitted up with steam are considered best, and it is preferred that the fresh fruit be introduced from the top of the evaporator stack rather than from the bottom, so that the vapors may be quickly carried off.

Illustrations are given of machines for paring and slicing apples, a hand parer being preferred for small plants. The one figured is capable of paring 50 bu. of apples in a day of 10 hours. Dropping the sliced fruit into salt baths for a few minutes before drying is preferred to bleaching the fruit by means of sulphur fumes.

The serious consideration of the subject of evaporating fruit is earnestly recommended to the farmers of the State.

Pear culture, W. B. ALWOOD (*Virginia Sta. Bul. 49, pp. 19–32*).—This bulletin treats of the cultural methods employed in the station pear orchard, with notes on the varieties grown. A stiff, calcareous clay soil, well drained, and preferably not sloping to the south, is considered best. In the opinion of the writer cropping the space between

the rows with a hoed crop may be practiced if the soil is fertile, but if not, green manuring accompanied by deep plowing and thorough tillage is recommended. Mulching is desirable for young orchards.

Directions are given for spraying against insects and fungus diseases with a lye wash and a combination of Bordeaux mixture and London purple.

Descriptive notes are given for 9 summer, 19 autumn, and 4 winter varieties, the following being recommended: Summer Doyenne, Lawson, Manning Elizabeth, Bartlett, Lucrative, Flemish Beauty, Seckel, Sheldon, and Easter Beurre.

A summary embodying the main points of the bulletin is appended.

The American persimmon, J. Troop and O. M. Hadley (*Indiana Sta. Bul. 60, pp. 43–54, pls. 6, figs. 3*).—This bulletin discusses the botanical characters, horticultural possibilities, culture, propagation, varieties, use, and composition of the persimmon or date plum (*Diospyros virginiana*). It is believed that more attention should be paid to the persimmon, and that in consequence of efforts to improve the fruit instead of the neglect it now receives this species may be developed into a valuable horticultural product. The species grows wild in most of the Southern States, but will ripen fruit as far north as the Great Lakes, and seems especially adapted to the soil and climate of the southern half of Indiana. The trees vary in height from 20 to 80 ft., according to the land on which they grow.

The flowers are diœcious, both the staminate and pistillate being born on the same tree, although some trees produce only staminate blossoms. The flowers are rich in nectar. The fruit is subglobose, from one-half to 2 in. in diameter, and borne on a very short fruit stalk. The number of seeds in the fruit varies from 2 to several, although some varieties are practically seedless. All persimmons possess a peculiar astringency when green, which is lost upon the fruit becoming ripe, from August to December, the time varying with the variety.

The propagation may be from the seeds or by means of budding or grafting, which should be done in the spring. The stocks for grafting should be at least 2 years old. The top working of old trees has been successfully performed, and is believed to be desirable in many cases.

The transplanting of persimmons is difficult on account of the long taproot; hence it is safest to transplant trees only 1 to 2 years old. The transplanting is best done in the autumn.

Persimmons grow on almost any kind of soil, from a rich bottom land to the poor thin soil of hilltops; but a warm, rich soil, with sunny exposure, is best adapted. They give best results under judicious cultivation and pruning.

The varieties Shoto, Early Bearing, Golden Gem, Daniel Boone, Hicks, Kansas, Smeech, and Early Golden are described, and several of the varieties illustrated from photographs. These varieties have

been recently improved from wild fruits, and are believed to be capable of still further improvement.

Directions are given for keeping persimmons by placing them in a cool, dry place, and for canning the ripe fruit by placing it in sirup in jars. A recipe is given for persimmon pudding.

The composition of the persimmon is discussed by H. A. Huston and J. M. Barrett, and tabulated data given showing the amount of pulp and seeds in persimmons and the chemical composition of the fruit. The percentages of pulp in 6 varieties of persimmon analyzed were found to range from 82 per cent to 88.5 per cent, and the number of seeds averaged 3 or 4. The following table shows the ash analyses of one of the varieties:

Ash analyses of persimmons.

	Ash from pulp.	Ash from seeds.
	Per cent.	*Per cent.*
Silica and traces of unburned carbon	1.520	20.120
Ferric oxid (Fe_2O_3)	.440	1.190
Manganese oxid (Mn_3O_4)	.060	.100
Calcium oxid (CaO)	4.740	6.760
Magnesium oxid (MgO)	2.230	6.960
Phosphoric acid (P_2O_5)	7.260	13.360
Sulphur trioxid (SO_3)	6.840	10.530
Potassium oxid (K_2O)	53.450	37.620
Sodium oxid (Na_2O)	2.360	.820
Carbon dioxid (CO_2)	15.940	.000
Chlorin	.300	.110
Moisture	4.320	2.520
	99.460	100.090
Less oxygen equivalent to chlorin	.067	.024
	99.393	100.066

Nut culture in the United States, W. P. CORSA (*U. S. Dept. Agr., Division of Pomology Special Report, pp. 144, pls. 16*).—This publication treats of the cultivation of the native and introduced species of nuts grown or capable of being grown within the limits of the United States. To a great extent it is based upon replies from growers in all parts of the country to a circular of inquiry.

The subject of nut culture in general is briefly treated, the question of propagation receiving most attention. The establishment of nut nurseries is advocated in preference to the procuring of young nut trees from the forests as being both cheaper and more productive of high-grade nuts. The nuts may either be planted where it is intended the trees shall be established in the orchard or may be set in a nursery and later transplanted to their permanent position. Only such nuts as are superior in size, flavor, and thinness of shell should be planted, unless budding or grafting is to be done upon the young trees. Nuts should be planted about 8 in. apart and 1½ to 2 in. deep, and the germination will be hastened by soaking the nuts for a few hours in warm water before spring planting. Fall planting—or better, stratification of nuts with light soil in a seed bed in the fall—is recommended. The processes of shield and flute budding and top, prong, cleft sap, crown,

root, and terminal cleft grafting are described, annular budding and cleft sap grafting being recommended. In addition, the harvesting and marketing of nuts in general are briefly noted.

The culture of the almond (*Amygdalus communis*) as followed in California is discussed at some length, with especial attention to the preparation for market. Descriptive notes are given on 18 varieties grown in the United States and 7 varieties imported from abroad.

Three species of walnut are cited as being of commercial importance in the United States, the black walnut (*Juglans nigra*), butternut (*J. cinerea*), and Persian walnut (*J. regia*). Elaborate cultural notes are given on the Persian or English walnut, which is grown extensively in California, and 20 varieties are described. Three species of Japanese walnuts are being introduced, and it is thought these may prove useful economic trees. Desirable nuts have resulted from the crossing of different species of walnuts. The black walnut and butternut are usually gathered from wild trees, but their domestication is urged and descriptive notes are given for 6 choice wild varieties of black walnut. The California walnut (*J. californica*) and another species (*J. rupestris*) are noted, and the first is believed to be desirable as a stock for the Persian walnut.

Of the several species of hickory nuts but 4 are considered worthy of the attention of nut growers, the pecan (*Hicoria pecan*), shagbark (*H. ovata*), shellbark (*H. laciniosa*), and one or two varieties of the pig nut (*H. glabra*). The culture of each of these is described, that of the pecan being treated at length. Annular budding has proved most successful with pecans, and descriptive notes are given on 16 choice varieties. Of the hickory nuts proper the shagbark is preferred and 12 named varieties are described.

The culture of the European hazelnuts or filberts (*Corylus avellana* and *C. tubulosa*) is described with some detail, and the adoption of like methods with the American hazelnuts (*C. americana*, *C. rostrata*, and *C. californica*) is urged.

The American chestnut (*Castanea dentata*), European chestnut (*C. sativa*), and Japanese chestnut (*C. japonica*) are discussed and directions given for their growing in orchards and preparation for market. Descriptive notes are given on 17 varieties of American chestnuts, 9 of European, and 15 of Japanese. In addition brief mention is made of the chinkapin (*C. pumila*) and Western chinkapin (*Castanopsis crysophylla*).

Nine species of pine trees are cited as yielding edible nuts, the piñon (*Pinus edulis*) affording the most plentiful crop of wild nuts.

The culture of the cocoanut (*Cocos nucifera*), which is now beginning to be grown extensively in southern Florida and the adjoining keys, is treated at some length, and the extension of this industry is recommended.

The bulletin concludes with remarks upon the following miscellaneous nuts: Beech (*Fagus atropunicea* or *F. ferruginea*), oaks (*Quercus* spp.), horse-chestnuts (*Æsculus* spp.), ginkgo (*Ginkgo biloba*), kola (*Sterculia acuminata*), cashew (*Anacardium occidentale*), leechee (*Nephelium litchi*), rambutan (*N. lappaceum*), tallow nut (*Stillingia sebifera*), catappa (*Terminalia catappa*), cream nut (*Bertholletia excelsa*), Chilean nut (*Guevina avellana*), Queensland nut (*Macadamia ternifolia*). betel (*Areca catechu*), and pistachio (*Pistacia vera*).

Two of the plates are colored, and the others are from pen and ink drawings, or from photographs, admirably illustrating the more prominent and important varieties treated in the text.

Variety tests of beans, W. M. HAYS (*Minnesota Sta. Bul. 46, p. 355*).—The yields and other data are tabulated for 14 varieties. The largest yield was given by Salzer White Wonder, 21.6 bu., followed by Early White Navy, Boston Pea, Choice Navy, Early Manly, and Early White Marrow.

Asiatic cantaloupes, R. R. HARRIS (*Garden and Forest, 9 (1896), No. 450, pp. 404, 405*).

Peas and sweet corn, H. P. GOULD (*Maine Sta. Bul. 27, pp. 4*).—Descriptive notes and tabulated data on varieties of peas and sweet corn tested at the station in 1895. Special notes are given on 8 varieties of wrinkled peas. Of the 25 varieties of sweet corn the variety Early Sunrise was most prolific and is preferred.

Radish growing under glass, B. T. GALLOWAY (*Amer. Gard., 17 (1896), No. 92, pp. 609, 610, figs. 3*).—Directions are given for growing radishes under glass and for preparing them for market.

American plums, F. A. WAUGH (*Garden and Forest, 9 (1896), No. 449, p. 398*).—Notes are given on some of the more prominent varieties of American plums.

Strawberries, C. W. MATHEWS (*Kentucky Sta. Bul. 62, pp. 45–57*).—Cultural and descriptive notes and tabulated data on 40 varieties grown at the station, of which the varieties Bubach, Haverland, Gandy, Crescent, Warfield, Michel, Downing, Lovett, and Enhance are considered the most desirable. The strawberries were grown in matted rows 2½ ft. wide and 4½ ft. apart, each variety comprising 2 dozen plants. A table gives the duration of yield, which extended from May 23 to June 18.

Small fruits, variety tests, S. B. GREEN (*Minnesota Sta. Bul. 45, pp. 321–325, figs. 2*).—This comprises brief notes on the yield of small fruits throughout the State in 1895, the amount being much less than usual owing to the preceding dry season.

Descriptive notes are given for 4 varieties of strawberries, 1 of dewberry, and the Logan berry, fruiting for the first time at the station.

Mention is made of attacks of the leaf curl and anthracnose of raspberries, the latter being held in check by spraying with Bordeaux mixture. An illustrated description is given of an apparatus for irrigating a strawberry patch by means of wooden troughs provided with holes at intervals.

Green manuring for grape vines, L. ROUGIER (*Prog. Agr. et Vit., 26 (1896), No. 31, pp. 118–121*).

Grapes under glass, W. SCOTT (*Garden and Forest, 9 (1896), No. 450, p. 406*).—Notes are given on greenhouse cultivation of grapes.

The Mills grape, F. C. SEARS (*Garden and Forest, 9 (1896), No. 449, p. 396*).—Notes are given on this grape, which is said to be a cross between Muscat, Hamburg, and Creveling. It is rather tender, but the fruit is a good keeper.

Carnations, old and new, T. D. HATFIELD (*Garden and Forest, 9 (1896), No. 450, pp. 406, 407*).

SEEDS—WEEDS.

On the influence of arsenic on the germination of seeds, B. Jönsson (*Kgl. Landt. Akad. Handl., 35 (1896), pp. 95–112*).—The influence of arsenic on the growth of plants has been studied by Nobbe,[1] Jäger,[2] and Lyttkens,[3] and in even the very dilute solution of one part of arsenic in one million a deleterious influence has been observed. Lyttkens has suggested that the arsenic content of superphosphates, which frequently amounts to about 0.1 per cent or more of arsenious acid, may in many cases account for a decrease in yields which has been laid to unfavorable climatic conditions, etc.

The author investigated the effect of the presence of arsenic in the germinating bed on the viability and the germinative energy of different kinds of seeds. The experiments were conducted with clover and various grass seeds, partly under bell glasses and partly in paper envelopes, the details being fully described.

The average germination observed was higher in the arsenic series than where the seeds were germinated on arsenic-free paper in every case but one. The author explains these results by the antiseptic action of arsenic upon the injurious organisms. Microscopic examinations showed that the germination paper containing arsenic was freer from foreign organisms than the arsenic-free paper.

In experiments with seeds kept in paper envelopes or covered with paper under bell jars, where the arsenic of the paper came in close contact with the seeds, a distinct arsenic poisoning was observed, the average decrease in the viability of seeds in the arsenic series being 4.4 per cent. The greatest average decrease for any one kind of seed was 15 per cent in a series of 5 trials with timothy.

The form in which arsenic was found in the paper used in the experiments could not be ascertained, on account of the small quantities present. Some experiments made with red-clover seed show that arsenious acid has a more marked effect in decreasing the viability of seeds than has arsenic acid, as is evident from the data given in the following table:

Germination experiments with red-clover seed.

Concentration of liquid.	Germination bed impregnated with— Arsenious acid.			Germination bed impregnated with— Arsenic acid.			Arsenic-free germination bed.		
	Viable seeds.	Hard seeds.	Non-viable seeds.	Viable seeds.	Hard seeds.	Non-viable seeds.	Viable seeds.	Hard seeds.	Non-viable seeds.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1:100	6.0	3.0	91.0	20.0	3.0	77.0	98.0	2.0	....
1:500	16.0	3.0	81.0	42.5	4.5	53.0	96.0	4.0	....
1:5,000	20.0	4.0	76.0	67.0	3.0	30.0	95.0	3.5	1.5
1:50,000	62.0	4.0	34.0	88.0	3.5	8.5	94.0	5.0	1.0
1:500,000	78.0	3.5	18.5	92.5	5.0	2.5	96.0	4.0	....

[1] Landw. Vers. Stat., 30 (1884), pp. 381–436.

[2] Ueber die Wirkung des Arseniks auf Pflanzen, Stuttgart, 1864.

[3] Kgl. Landt. Akad. Handl., 1894 (E. S. R., 5, p. 1011).

The author discusses the influence of arsenic on vegetation at some length, and especially the root growth in arsenic-bearing media. While arsenic is deleterious in water culture, this may not necessarily be the case when the poison is present in the soil in solid form.—F. W. WOLL.

Testing garden seeds, L. F. KINNEY and G. E. ADAMS (*Rhode Island Sta. Bul. 35, pp. 131–167, figs. 6*).—A report is given of the results obtained from tests of 233 samples of seed representing standard varieties of common vegetables. The seeds were purchased in the open market and were represented as having been secured from 19 different seedsmen. The methods of testing are described in full, and a tabulated statement is given in which is shown the data secured for each variety during the test. For comparison the authors have adopted standards of vitality and purity, which are proposed as standards for good merchantable seed. Numerous diagrams are given showing the relative value of the seed from the different dealers, comparing them with the proposed standards. Tables are given showing the average vitality and purity of the samples tested, the average weight of 100 seed in grams and the average number of seed in an ounce of each kind of seed.

In the material examined there was little foreign matter present, but in quite a number of samples a considerable proportion of dead seed was present, as much as 75 per cent in some cases. Many of the samples fell below the value required by the standard.

Latent life of seed, V. JODIN and A. GAUTIER (*Compt. Rend., 122 (1896), No 23, pp. 1349–1352*).—Notes are given of experiments conducted with air-dried peas that were sealed in vessels for various lengths of time. Analyses are given of the atmosphere showing a slight loss of oxygen due to intramolecular respiration. One lot of 20 seeds that was sealed up for 4 years and 7 months retained its germinative ability. In another lot of 20, half were removed in 4½ years, when 8 germinated readily and 2 rotted without sprouting. The remaining 10 were tested in 6¼ years and 2 germinated and grew, 2 germinated with difficulty, and 6 rotted without sprouting. In one experiment the average amount of oxygen annually absorbed by a seed was 0.036 cc.

Germination of Lathyrus sylvestris seed, C. O. HARZ (*Deut. Ztschr. Theirmed. und vergleich. Pathol., 1896, Suppl. 19, pp. 59–66; abs. in Bot. Centbl., 67 (1896), No. 8, p. 249*).—The author tested 10 lots of flat-pea seed under a bell jar and the average time required for germination was 351 days. Experiments conducted in the field showed that from 1 to 1½ years were required for germination.

On the influence of fertilizers on germination, G. DE MARNEFFE (*Ingenieur agricole Gembloux, 1896, No 11*).

On the examination of commercial seed, F. F. BRUIJNING (*Arch. Musée Teyler, ser. 2, 5 (1896), No. 1, pp. 1–14; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 4, pp. 319, 320*).—Notes are given of the examination of commercial seed and clover seed with the view of ascertaining their purity and the nature of their impurities.

On the eradication of colchicum, C. DENAIFFE (*Prog. Agr. et Vit., 26 (1896), No. 33, pp. 189, 190, figs. 4*).—An instrument is described for raising the bulbs from the ground.

Dodder on garden vegetables, B. D. HALSTED (*Garden and Forest, 9 (1896), No. 446, pp. 365, 366, pl. 1*).—Notes are given on a species of Cuscuta growing on onions and egg plants.

An attempt to combat dodder and Rhizoctonia of alfalfa, L. DEGRULLY (*Prog. Agr. et Vit., 26 (1896), No. 31, p. 115*).—The use of crude ammonia is recommended.

Weeds in our fields, W. M. HAYS (*Minnesota Sta. Bul. 46, pp. 373–383, pls. 2*).—Notes are given on the occurrence, methods of distribution, and habits of the foxtail grasses (*Setaria viridis* and *S. glauca*), lamb's-quarters (*Chenopodium album*), pig weed (*Amarantus retroflexus*), yellow mustard (*Brassica sinapistrum*), and wild oats (*Avena fatua*), and methods are suggested for their eradication.

Notes on compass plants, E. J. HILL (*Garden and Forest, 9 (1896), No. 450, pp. 407, 408*).

The cocklebur, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 421–423, pl. 1*).—Notes are given on *Xanthium strumarium*.

The weeds of New South Wales, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 428, 429*).—Supplementary notes are given of *Melilotus parviflora, Conium maculatum, Xanthium strumarium, Amarantus paniculatus*, and *A. frumentaceous*.

DISEASES OF PLANTS.

Potato diseases on Long Island in the season of 1895, F. C. STEWART (*New York State Sta. Bul. 101, n. ser., pp. 70–86*).

Synopsis.—General observations are given of potato diseases, together with notes on spraying potatoes, on internal browning of potatoes, a new stem blight, pimply potatoes, and a new Fusarium on potato stems.

The most troublesome diseases are the early and late blights which the author states may be controlled by spraying the plants 5 or 6 times with Bordeaux mixture, beginning when they are about 6 in. high and repeating the application every 2 weeks. Experiments are quoted showing a gain of 62 bu. per acre where the plants had been sprayed 5 times, and 52 bu. where 3 applications were given them. In spraying the plants Paris green may be added to the Bordeaux mixture, the combination being more efficient than either when used alone against potato bugs and flea beetles.

The internal browning of the tubers which has been reported in Minnesota[1] was observed upon Long Island in 1894. The cause of the disease is thought to be physiological, as all attempts to cultivate any organism or to inoculate sound tubers failed. There are thought to be some reasons for suspecting that rapid growth favors the appearance of the disease, since it is seldom observed upon small potatoes or those produced late in the season when growth is slow. Experiments were conducted to ascertain the effect of using diseased tubers for seed potatoes. The author's conclusions, based upon a single experiment, are:

"(1) The disease of potatoes known as 'internal brown rot' or 'internal browning' is not transmitted from seed to product;

"(2) The greater the amount of 'interior browning' in the seed tubers the smaller the yield. It is therefore not advisable to plant tubers so affected."

[1] Minnesota Sta. Bul. 39 (E. S. R., 7, p. 136).

During 1895 a new stem blight of potatoes was observed upon Long Island and also in Dutchess and Orange counties. The disease is characterized as follows:

"First, there is a cessation of growth. The topmost leaves take on a yellowish, or in some varieties a purple color, and roll inward from the edges and upward, exposing the under surfaces. This condition is followed by wilting and complete drying up of the entire foliage, the process taking from 1 to 3 weeks. The tubers appear to be sound, but when cut at the stem end blackened fibers are seen penetrating the flesh to a considerable distance, materially injuring it for cooking purposes. No rot develops in the tubers. The stem just beneath the surface of the soil first shows discolored spots and later becomes dry and shriveled."

The disease seems not to be dependent upon weather conditions nor varieties. In some cases it seemed worse upon upland soil than on moister lowlands. The author thinks it possible that the disease is due to *Oöspora rosea*, since that fungus is nearly always present in diseased stems after the death of the plants. Nothing is known about preventive treatment, spraying not being able to control it.

The author's attention was called to a peculiar potato trouble to which the name "pimply potatoes" was given. Numerous minute elevations are distributed over the surface of the tuber. When examined they were found to be caused by corky deposits under the epidermis and were thought to have originated from insect punctures. From the absence of eggs or larvæ the attacks were probably made for feeding purposes.

A report is given of a new Fusarium that attacks potato stalks. The stalks appear as though girdled in various places by a pink fungus. The disease appears about midsummer, spreads rapidly for a few days, and then disappears. The fungus was characterized by Ellis and Everhart[1] as follows:

"*Fusarium acuminatum.*—Sporodichia gregarious, minute, white at first, then flesh-colored, attenuate acuminate at each end, 3 to 5, exceptionally 6 septate, not constricted, arising from slightly elongated cells of the proligerous layer, in which respect it differs from the usual type of Fusarium. Quite distinct from *F. diplosporum*, which occurs on the same host."

Bacteriosis of carnations, J. C. ARTHUR and H. L. BOLLEY (*Indiana Sta. Bul. 59, pp. 15–39, pls. 8*).—This disease, which appears to be very widely spread, attacks the leaves, being found only rarely upon other parts of the plant, and checks the growth of the plant and reduces the size and number of flowers. It may be recognized by the small pellucid dots scattered irregularly over the leaves, and is said to be of bacterial origin, the organism having been given the name *Bacillus dianthi.* The disease usually starts when the leaves are quite immature and the surface of the leaf may sometimes be slightly raised over the dots, making watery pimples. Later the surface of the leaf above the spot changes, indicating the spot, and as it extends to the inside of the leaf the surface becomes dry, the internal tissues collapse, and

[1] Proc. Philadelphia Acad. Sci., 1895, p. 441.

whitish sunken spots appear. Very badly diseased plants usually have their leaves more yellowish-green than normal, more transparent, and usually smaller.

The disease has been under investigation since 1887-'88, but it was determined to be of bacterial origin in 1889, when Mr. Bolley carried on extensive investigations on the biology of the organism. The methods of isolation and cultivation of the germ are given in detail as well as its morphological characteristics. It is said to be an aërobic germ. while in another place we read "in hydrogen under pressure the growth was to all appearance normal, but with very faint coloration."

Inoculation experiments were conducted with varying success, probably due to the almost universal presence of the disease in the plants or lack of purity of the cultures. In January, 1890, three seedlings were inoculated and "the disease became manifest in 6 days," seeming to indicate successful inoculations, but the later statement that scarcely a plant could be found in doors or out that did not show the disease would suggest the possible infection of the plants before inoculation.

It is said that no variety of carnations is wholly immune from attacks of this organism, although they vary considerably in their susceptibility, and that it may be conveyed to other pinks through inoculations. The disease is considered as common throughout eastern North America, occurring wherever carnations are extensively grown.

For the prevention of the disease the plants should be kept as dry as possible, watering to be done between the rows, so as not to wet the foliage. An occasional spraying on bright days with water containing a small quantity of ammoniacal carbonate of copper will also be found advantageous.

Report on black rot in Armagnac during 1895, G. LAVERGNE (*Bul. Min. Agr. France, 15 (1896), No. 2, pp. 285-291*).—A report is given of field experiments in southwestern France for the repression of black rot of grapes. During 1894 the disease was very destructive, and a special commission was appointed to conduct experiments for its prevention. The meteorological conditions were very unfavorable during the experiments on account of heavy rains and numerous fogs. Seventeen plats were used in this work, applications being made of lysol, verdigris, Bordeaux mixture, Bordeaux sucrate, tannin copper mixture, Burgundy mixture with and without molasses, Bordeaux mixture alternating with sulphur, copper sulphosteatite, and sulphur and sulphate of copper applied in the form of a powder, from 2 to 5 applications being given at various times.

The results obtained expressed in percentages of loss due to black rot at the end of July and at the time of harvest are tabulated. The most successful treatment was 5 applications of 3 per cent Bordeaux mixture, the first spraying being given the vines May 2, the last July 17. This treatment prevented any appearance of disease at the end of July and a loss of but 3 to 5 per cent of the fruit at harvest. When but 2

sprayings were given on one plat, the first applications on June 25, the loss was 75 to 80 per cent. The early applications were in every case the most successful, but no treatment equaled the earliest use of Bordeaux mixture, showing the decided advantage accruing from preventive treatment. By the destruction of all diseased leaves and grapes that may remain dried in the vineyard and careful spraying, begun early, of all the green parts of the plant, together with attention to the wood of the vines where the spores may lodge, it is considered possible to prevent any considerable loss from black rot.

Potato rot, H. P. GOULD (*Maine Sta. Bul. 28, pp. 4*).—Brief notes are given descriptive of potato rot and its effect upon the plant and tuber, together with a summary of experiments with Bordeaux mixture and "fungiroid" for its prevention. The use of Bordeaux mixture as a preventive gave the most satisfactory results. "Fungiroid" is a fungicide which, it is claimed, is a powdered form of Bordeaux mixture. The total yield was less and a greater percentage of rotten tubers were present where "fungiroid" was used than where Bordeaux mixture was employed, although "fungiroid" gave better results than where no application of fungicides was made.

A review of the diseases of the sugar cane in Java, I, J. H. WAKKER and F. A. F. C. WENT (*Med. Proefsta. East Java, n. ser., No. 22, pp. 11, pl. 1*).—Notes are given on the following diseases and fungi attacking the sugar cane: *Ustilago sacchari*, *Thielaviopsis æthaceticus*, *Colletotrichum falcatum*, *Marasmius sacchari*, red rot, sour rot, *Cercospora köpëi*, *Uredo kühnii*, *Coleroa sacchari*, *Leptosphæria sacchari*, *Cercospora sacchari*, *C. vaginæ*, *Pestalozzia* sp., the "sereh disease," a yellow striped leaf disease, a striped disease of the roots, chlorosis of the heart leaves, a heart disease of the young plants, and a red spot disease of the leaves.

A new disease of tobacco, J. VAN BREDA DE HAAN (*Med. 's Lands Plantentuin, No. 15, pp. 107, pl. 1*).—The author gives a report of a disease of tobacco that has made its appearance in certain districts in Java. The leaves become dark spotted and greatly depreciate in value. The cause is attributed to *Phytophthora nicotianæ* n. sp., a technical description of the fungus being given, with illustrations. A study of the biology of the parasite has been made and various attempts undertaken for the repression of the disease. The author thinks it can be prevented from spreading by careful attention to and frequent change of the plant beds and by spraying the plants with Bordeaux mixture, otherwise the disease threatens to become a serious enemy to tobacco culture.

Smut in wheat, W. M. HAYS (*Minnesota Sta. Bul. 46, pp. 362–368*).—Popular notes are given of the stinking smut or bunt of wheat. During 1895 a series of experiments was conducted for the prevention of this disease by preliminary treatment with solutions of different strengths of copper sulphate and by the hot-water method of prevention.

The experiments with the copper sulphate consisted of either sprinkling the grain with the solutions or dipping the grain into the solutions, and after each treatment part of the seed was limed and part not limed. In the hot-water treatment the temperatures employed were, for first dipping, 120° F., and for the second 130 or 135°, the times of immersion varying from 2 to 10 minutes. The best results obtained were those in which the seed was dipped until thoroughly wet in a solution of ½ lb. copper sulphate to 16 gal. water, after which it was dried in lime; and in the hot-water treatment, where the grain was soaked in water at 120° for 10 minutes and then for 10 minutes at 135°. In each case 0.1 per cent smutted plants were grown from the seed as compared with from 11 to 20.6 per cent in the check lots. Soaking the seed in cold water for 15 minutes gave 10.4 per cent smut, and in a saturated salt solution 3.3 per cent. Full directions are given for all the different treatments.

The smut of oats and its prevention, A. D. SELBY (*Ohio Sta. Bul. 64, pp. 115–139, pl. 1*).—Notes are given upon the botanical characters of the fungus, its life history, and historical facts relative to its spread and the amount of damage it is thought to do in decreasing the yield of the crop. The author estimates that about 6 per cent of the oat crop of his State is destroyed each year by the smut. Directions are given for the hot-water and the potassium-sulphid treatment of seeds before sowing. The results of plat experiments with these treatments for the prevention of the disease are tabulated, and it is shown that there is an increased yield from treated seed, in addition to the prevention of smut, that is sufficient to pay the cost of treatment.

Combating carnation rust, F. C. STEWART (*New York State Sta. Bul. 100, n. ser., pp. 36–68, figs. 2*).—Notes are given on the history and distribution of carnation rust, together with a résumé of treatments suggested and tested for its prevention. Bordeaux mixture, fostite, potassium sulphid, carbolic acid, copper sulphate, and copper sulphate in ammonia have been tried with conflicting results.

The author investigated the effect of different strengths of solutions of copper sulphate, common salt, and potassium sulphid upon the germination of the rust spores. The spores were found to germinate readily in 1 to 1,000 copper sulphate and there was some germination in as strong solutions as 1 to 300. The spores are able to germinate in salt solutions up to 1 to 45, while 1 to 3,000 of potassium sulphid prevented all germination. Soaking cuttings in different strengths of copper-sulphate solutions showed that the plants were injured in most cases where the strength of the solution was sufficient to prevent the germination of the fungus spores. Cuttings soaked for a half hour in a 1 to 134 solution of potassium sulphid rooted better and were more vigorous than untreated cuttings.

All attempts at curative treatment failed and the trials for preventive treatment were not wholly successful in preventing disease. For

preventive treatment solutions of potassium sulphid, copper sulphate, and Bordeaux mixture were tested and at "lifting" time the percentage of rusty plants on the different plats was 43½, 42, and 100, respectively.

The author recommends the growing of varieties least subject to rust and spraying all plants once a week with a solution of copper sulphate (2 lbs. to 45 gal. of water) or potassium sulphid (1 oz. to 1 gal. of water). Before bringing in plants in the fall all houses should be thoroughly fumigated, and careful greenhouse management will aid in controlling or preventing rust attacks.

Treatment for potato diseases, S. B. GREEN (*Minnesota Sta. Bul. 45, pp. 307–312, figs. 2*).—A report is made on potato scab, internal brown rot, and potato blight. For the scab the corrosive sublimate treatment was tried, and it greatly reduced the amount of scab on treated plats over plats where the seed tubers had received no treatment. The soil in which the potatoes were grown had never grown them before, and the infection must have come from the seed tubers.

The internal brown rot did not appear as troublesome as during the previous year. A crop grown from diseased tubers showed no indication of the disease until late in the winter, while the potatoes were in storage. Such tubers should not be employed for seed.

A report is given of experiments conducted with Bordeaux mixture for the prevention of potato blight. From 1 to 4 applications were given, and based upon the experience of the past 2 years the author says that little if any increase due to the treatment was observed.

A spot disease of barley leaves, STEGLICH (*Sächs. landw. Ztschr., 44 (1896), No. 32, pp. 397–399, figs. 3*).

Investigations on potato scab, FRANK and KRÜGER (*Ztschr. Spiritus Ind., 1896; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 189–191*).

The yellowing of sugar beets, J. FROUDE (*Sucrerie indig., 48 (1896), No. 12, pp. 338–340*).—A preliminary report is given on a trouble of sugar beets which seems to be of physiological origin. It causes a marked reduction in the yield and sugar content of the beets.

On the variety of rust affecting Australian wheats, J. ERIKSSON (*Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 141–144*).—The author states that the most common rust on Australian wheats is *Puccinia dispersa*, *P. graminis* occurring sparingly and *P. glumarum* not observed.

A spot disease of celery (*Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 191, 192*).—Notes are given of a Septoria disease of celery.

Diseases of peach trees (*Bol. entomol. agrar. e pat. veg., 3 (1896), pp. 75, 76; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 3, p. 169*).—Notes are given on gumming, leaf curl, and leaf crumpling insects.

Observations on the control of black rot, A. LARROZE (*Prog. Agr. et Vit., 26 (1896), No. 38, pp. 326–329*).

Report of the black rot congress at Ager, L. DEGRULLY (*Prog. Agr. et Vit., 26 (1896), No. 38, pp. 317–321*).—A brief report is given of the proceedings in which Bordeaux mixture was shown to be the best means for controlling black rot.

Notes on the pine-inhabiting species of Peridermium, L. M. UNDERWOOD and F. S. EARLE (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 437*).—A revision of the species of the eastern United States is given and the difference in swellings caused by *Peridermium cerebrum* on *Pinus tæda* and *P. echinata* was pointed out.

A tobacco sickness of soil (*Ber. Baden landw. Bot. Ver. Sta., 1896; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 3, p. 185*).—Notes are given of the occurrence of nematodes in such soil, also on the presence of *Cuscuta europæa* on tobacco.

Concerning plant injuries due to smoke, SCHROEDER (*Ueber die Beschädigung der Vegetation durch Rauch. Freiberg: 1895, pp. 35; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 158, 159*).

Some plant diseases in the United States and the means for combating them, B. T. GALLOWAY (*Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 174–178*).—This article consists in popular descriptions of potato diseases and the means for their prevention.

Concerning plant diseases in Denmark, E. ROSTRUP (*Ztschr. Pflanzenkrank., 6, (1896), No. 3, pp. 151–155*).

On the spread of fungi by snails, G. WAGNER (*Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 144–150*).

The hot-water treatment for the prevention of smut of oats, wheat, and barley, E. S. GOFF (*Wisconsin Sta. Bul. 50, pp. 13, figs. 5*).—The author represents diagrammatically the value of the oat crop of 1894, its cost of production, and the increase that might have been added to the profits had the seed oats been treated by the hot-water method before sowing. The money value of this possible increase is placed at $1,500,000. Directions are given for the treatment of oats, wheat, and barley by the Jensen or hot-water method for the prevention of smut, the different utensils required being fully described.

Ceres-pulver, a new fungicide for the treatment of smuts, W. A. KELLERMAN (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 438*).—The author reported upon the value of "ceres-pulver," which consists mainly of potassium sulphid, as a means for preventing oat and barley smut. The results obtained in his experiments have led the author to recommend the use of this preparation as an efficient means for preventing smut on oats and barley. Pure potassium sulphid is also recommended.

Spraying apparatus, S. B. GREEN (*Minnesota Sta. Bul. 45, pp. 326–328, figs. 2*).—Descriptions are given of a cheap though good spray pump and an improved strainer for Bordeaux mixture. The advantages claimed for the pump are a powerful pump adapted to all sorts of heavy work, easily worked, conveniently transported, and of simple construction. The strainer, which consists of a cone of copper gauze soldered to a galvanized-iron rim, is said to remain unclogged better than ordinary forms.

Spraying for fruit diseases, B. T. GALLOWAY (*U. S. Dept. Agr., Farmers' Bul. 38, pp. 12, figs. 6*).—This is a popular bulletin on the preparation and use of fungicides as remedies for plant diseases. The results of recent investigations are stated in a concise form, and specific directions are given for preventive treatment of the diseases of the grape, apple, pear, quince, cherry, and plum.

Notes on spraying, W. M. MUNSON (*Maine Sta. Bul. 29, pp. 4, figs. 4*).—Brief illustrated notes are given of different forms of spraying apparatus, together with formulas for the preparation and application of Bordeaux mixture, ammoniacal copper carbonate, kerosene emulsion, and hellebore.

ENTOMOLOGY.

The spinach leaf maggot or miner, F. A. SIRRINE (*New York State Sta. Bul. 99, n. ser., pp. 20–31, pl. 1*).—This bulletin reports the results of investigations of the spinach leaf maggot (*Pegomyia vicina*), which has been proving quite injurious to the spinach crop in the market-garden district of Long Island. It attacks both the late spring and fall crops, and has been doing damage for the last 2 years, feeding upon beets and lamb's-quarters (*Chenopodium album*) in addition to spinach.

The adult flies are inconspicuous, flying near the surface of the ground

and depositing their eggs in small numbers on the lower surfaces of the leaves. The larva buries itself within the leaf tissue immediately upon hatching, and at once commences to feed in a thread-like mine which forms the curve of an entire semicircle. Before long the mine appears as a blistered blotch in which often 3 or 4 larvæ are found feeding together. The pupa state is usually passed in the loose soil or under fallen leaves, although occasionally it is undergone within the leaves. The life cycle probably varies from 2 to 4 weeks, thus enabling the species to produce 6 or 7 broods annually, the last passing the winter in the pupa stage. The various stages of the insect's life history are described and illustrated from photographs and the species is historically discussed.

A bug (*Coriscus inscriptus*) feeds upon the larvæ, piercing them with its beak as they lie in their mines within the leaves, although the operation itself has not been seen.

Although some damage is done to beets, by far the most is produced in the case of spinach, and combating the insect is made more difficult because of its feeding upon lamb's-quarters at times when spinach and beets are not available.

For controlling the pest are recommended clean cultivation, destroying all plants of lamb's-quarters, combined with late fall or early spring plowing of old spinach and beet fields to so bury the pupating insects that it will be impossible for them to emerge. This plowing should be deep and preferably followed by rolling of the ground.

Some injurious insects, G. C. DAVIS (*Michigan Sta. Bul. 132, pp. 30, figs. 21*).—This bulletin consists of illustrated, descriptive, and life-history notes on climbing cutworms, granary insects, and carpet beetles and clothes moths. The speckled cutworm (*Mamestra subjuncta*), white cutworm (*Carneades scandens*), spotted-legged cutworm (*Prosagrotis vetusta*), well-marked cutworm (*Noctua clandestina*), dingy cutworm (*Feltia subgothica*), and variegated cutworm (*Peridroma saucia*) are treated. As the means of control, clean cultivation, wool bands, caterpillar and insect lime, and the use of poisoned buds are recommended.

Of insects injurious in granaries, the saw-toothed grain beetle (*Silvanus surinamensis*), granary weevil (*Calandra granaria*), Angoumois grain moth (*Gelechia cerealella*), flour beetles (*Tribolium ferrugineum* and *T. confusum*), Mediterranean flour moth (*Ephestia kuehniella*), meal snout moth (*Pyralis farinalis*), Indian meal moth (*Plodia interpunctella*), common meal worm (*Tenebrio molitor*), and cadelle (*Tenebrioides mauritanicus*) are figured and described.

Care and cleanliness, to prevent the entrance of insects into granaries, are urged, and for the destruction of the species found in the granaries the use of carbon bisulphid is preferred.

The buffalo carpet beetle (*Anthrenus scrophulariæ*), bushy tipped carpet beetle (*Attagenus piceus*), and two clothes moths (*Tinea bisselliella* and *T. pellionella*) are described and their habits noted, gasoline being recommended as a remedy against all 4 species.

Gall formation and the transformations of Cynips calicis, etc., M. W. BEYERINCK (*Verh. Kgl. Akad. Wetenschap. Amsterdam, 2 (1896), Sec. 5, No. 2, pp. 43; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 17, pp. 563–568*).

The apple maggot, J. J. WILLIS (*Gard. Chron., ser. 3, 20 (1896), No. 508, p. 331*).—Brief notes are given on *Trypeta pomonella*.

Concerning kerosene emulsion, W. M. SCHÖYEN (*Ztschr. Pflanzenkrank., 6 (1896), No. 3, pp. 150, 151*).—Notes are given on the preparation and use of this important insecticide.

Insecticide for combating aphides, B. LIEBIG (*Amer. Forest, 12 (1896), No. 434, p. 189*).—Spraying the under side of leaves and around the stems of plants with a solution of 10 parts soft soap, 50 of quassia powder, 5 of salicylic acid, and 200 of alcohol is said to protect them from aphides.

A bacterial disease of the squash bug, B. M. DUGGAR (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896: abs. in Science, n. ser., 4 (1896), No. 91, p. 432*).—A brief description was given of a bacterial disease of the squash bug (*Anasa tristis*) together with a report of successful experiments upon both squash and chinch bugs. The isolation, growth, and characteristics of the bacillus were given. Mention was made of a toxic principle excreted by the organism, in an infusion of which insects died almost as soon as immersed.

FOODS—ANIMAL PRODUCTION.

Investigations on respiration and the total metabolism of man, K. SONDÉN and R. TIGERSTEDT (*Skand. arch. Physiol., 6 (1895), No. 1–3, pp. 1–224, pls. 5, dgms. 35*).—The authors describe a respiration apparatus which has been built at the physical laboratory of the Carolien Medical-Surgical Institute at Stockholm. The apparatus is of the Pettenkofer type, but is very much larger than those previously used, since it has a cubical content of 100.65 cubic meters. It is really a small air-tight room lined with zinc. In making the experiments a current of air was pumped through in somewhat the same way as in the Pettenkofer apparatus. The moisture in the air was determined by means of Sondén's hygrometer, the August psychrometer, and the dewpoint apparatus. The carbon dioxid was measured by a modification of the Pettenkofer-Voit methods. The authors made a number of control experiments with burning lamps of various sorts to furnish heat and wet cloths to furnish moisture, and believe that their measurements of water are accurate within 7.1 per cent and of carbon dioxid within 1.16 per cent. The apparatus was so large that a number of persons could enter at the same time.

A large number of experiments with men, women, and children were made. They were divided into 4 classes: (1) On total daily excretion of carbon dioxid by men and women of different ages, (2) on the excretion of carbon dioxid and nitrogen by man at different hours in the day, (3) on the influence of muscular work upon carbon dioxid excretion, and (4) on the total metabolism of individuals of different ages.

(1) Under the first class 18 experiments with 122 men and boys ranging from 7 to 57 years old were made, and 15 experiments with 111 women and girls ranging from 8 to 66 years old. The results are given in detail in tabular form. The following conclusions were reached:

The carbon dioxid excretion of boys increases so little between the

years of 9 and 12 that the difference is within the limit of experimental error. The excretion amounts to 33 to 34 gm. per hour. In the thirteenth year the carbon dioxid increases to about 42 to 45 gm. per hour, and remains about the same until the nineteenth year. From the twentieth year on the amount diminishes. For men between 20 and 30 it is 38 gm. per hour, and between 35 and 60 it is from 34 to 37 gm. per hour. With girls the carbon dioxid excretion between the ages of 8 and 10 is 23 to 25 gm. per hour. It then increases but does not show as great an increase as in the case of boys; and from the eleventh to the thirtieth year it varies only between 26 and 32 gm. As women grow older the carbon dioxid excretion seems to diminish somewhat. In the sixty-fifth year it is about 26 gm. per hour.

In the case of both males and females the carbon dioxid excretion per kilogram body weight is greater in young (and light) than in old (and heavy) individuals, and the amount excreted per square meter of body surface is greater in young than in older persons. The latter fact indicates that in youth, leaving out of consideration the small size of the body, metabolism is really more active than in old age. In youth the excretion of carbon dioxid per kilogram body weight and per square meter body surface is much greater by males than by females of the same age and weight, viz, in the ratio of 140 to 100 on an average. This difference between the sexes, which is so marked in youth, seems gradually to diminish and finally in old age to disappear entirely.

(2) A large number of experiments of the second class were made, in which the carbon dioxid, and in some cases the nitrogen, were measured at frequent intervals and under varying conditions. The following conclusions were drawn:

Generally speaking, when no work is done the hourly variation of carbon dioxid excretion is comparatively small. In 44 experiments made with 9 individuals the mean hourly variation in 5-hour periods was 6.19 per cent. When periods of labor occurred between periods of rest the variations were not much greater. In 63 experiments made with 7 individuals in a 5-hour period, in which rest and labor alternated, 3 hours being devoted to rest, the mean hourly variation observed during rest was 6.84 per cent of the mean value for the 3 hours at rest.

In the same individuals under the same external conditions the carbon dioxid excreted varies very little from day to day; even though the experiments are separated by several months the variation is only 9.6 per cent of the mean daily value. During the 24 hours considerable variations occur which in the main are caused by sleeping and waking. On an average the carbon dioxid excreted in sleep is to that excreted in waking as 100 to 145. The extremes are 100 to 169 and 100 to 132. When awake the mean variation during 2-hour periods in 82 observations made with 11 individuals was 9.32 per cent of the mean value. In sleep the mean variation during 2-hour periods in 42

observations made with 11 individuals was 6.84 per cent of the mean value, that is, one-third smaller than during waking. The minimum carbon dioxid excretion per square meter body surface in sleep in the case of 11 and 12 year old children is 52 per cent greater than that of aged persons, and in the case of young people of 18 to 20 years it is 17 per cent greater.

The daily variations in the temperature of a man at rest are chiefly and very probably entirely caused by the daily variations in the intensity of metabolism.

The experiments with nitrogen are discussed in detail, but the general conclusions are not summed up as in the case of carbon.

(3) A number of experiments were made in which the subjects performed muscular labor of various sorts—for instance, walking, climbing up and down a ladder, and working with an ergostat (Gärtner's). The following conclusions were reached:

When muscular work is performed the increase of carbon dioxid excretion is so great that it is hardly possible that work is done at the expense of protein. The labor which must be expended to move 1 kg. of the body 1 step forward increases the carbon dioxid production 0.000102 gm., the limit of error being ± 0.000006 gm. The motion of forward progression of 1 kg. body weight through 1 meter increases the carbon dioxid production 0.000149 gm., the limit of error being ± 0.000008 gm. In climbing a ladder each kilogrameter expended for external work increases the carbon dioxid production 0.00214 gm., the limit of error being ± 0.00006, provided the same amount of energy is expended in the ascent and descent. If the work is performed at the expense of carbohydrates 42.4 per cent of the energy is utilized.

In turning a crank each kilogrameter of energy expended for external work increased the carbon dioxid production 0.00368 gm., the limit of error being 0.00013 gm. If the work is performed at the expense of carbohydrates 24.7 per cent of the energy is utilized.

(4) In the metabolism experiments the food and feces were not measured or analyzed. The nitrogen in the urine was determined and the carbon calculated. The authors intend to make more extended investigations, and the results already published are not summed up as in the other cases.

Throughout this report the authors make many references to the work of other investigators and quote many of their results.

The food value of ground cotton seed as compared with cotton-seed cake, R. CHRISTY (*Reported by B. Dyer in Deut. landw. Presse, 23 (1896), No. 3, pp. 22, 23*).—Two feeding tests were made with black-headed Suffolk yearling sheep at Roxwell, Chelmsford, England. The object was to determine the relative value of ground cotton seed, which contains all the oil of the seed, and cotton-seed cake. The first trial was begun with 2 lots of 19 sheep. They were pastured in a meadow and fed kohl-rabi and later ruta-bagas and chopped barley or oat straw.

In addition, lot 1 was fed cotton-seed cake and lot 2 ground cotton seed. The experiment was divided into 3 periods of 39, 34, and 26 days. At the end of the first period 6 sheep were dropped from lot 1 and 7 from lot 2. The average weight per animal at the beginning of the experiment, gain in weight, food consumed, and cost of food are shown in the following table:

Results of feeding cotton-seed cake and ground cotton seed.

	Weight at beginning.	Gain in weight.	Concentrated food consumed.		Cost of cotton seed and cake.
			Cotton-seed cake.	Ground cotton seed.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*s. d.*
Lot 1 (cotton-seed cake)	104.1	30.5	72.75	....	2 6½
Lot 2 (ground cotton seed)	98.0	36.7	....	67.5	3 5½

The lot receiving ground cotton seed made a larger gain than the lot receiving cotton-seed cake. The excess of gain cost 2d. per pound. At the conclusion of the experiment the sheep were shorn. The average yield of wool of lot 1 was 7.7 lbs.; of lot 2, 8.3 lbs. The sheep were slaughtered. It was found that the yield of meat and tallow of each lot was the same.

The second trial was made with 2 lots of 12 Lincoln-Hampshire sheep. They were pastured in a clover meadow and were fed ½ bu. of cut roots and 1 lb. of chopped straw per head per day. In addition lot 1 received 1 lb. of cotton-seed cake per head and lot 2 received 1 lb. of ground cotton seed. The trial began April 19 and continued 59 days. It was divided into 2 periods of 39 and 19 days, respectively. The average weight per animal, gain in weight, food consumed, and cost of food for the whole trial are shown in the following table:

Results of feeding cotton-seed cake and ground cotton seed.

	Weight at beginning.	Gain in weight.	Concentrated food consumed.		Cost of cotton seed and cake.
			Cotton-seed cake.	Ground cotton seed.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Shillings.*
Lot 1 (cotton-seed cake)	128	41.2	5.8	....	2
Lot 2 (ground cotton seed)	128	46.7	....	58	3

In this case also the lot fed ground cotton seed made a greater gain than the other. The excess of gain cost 2½d. per pound. The animals of each lot were weighed before and after slaughtering. The average loss in weight in slaughtering of lot 1 was 77 lbs. and of lot 2 72.75 lbs. All the sheep had too much tallow.

The conclusion is reached that it is much more profitable to feed sheep a fodder rich in fat.

Molasses feed (*Landmansblade, 29 (1896), pp. 1–4*).—Molasses feed is manufactured by the Danish beet-sugar factories from palm-nut meal, wheat bran, and molasses in the proportions of 1:3:4. According to an analysis made by V. Stein, it has the following composition:

	Per cent.
Crude protein	13.69
Fat	1.14
Crude fiber	6.16
Nitrogen-free extract (containing 43.9 per cent sugar)	55.83
Mineral substances	7.22
Water	15.96

On account of the large proportion of alkali salts in the feed, it will cause scouring if fed too freely. It is recommended to begin with very small quantities, gradually increasing the allowance until full rations are fed, which are 8 to 10 lbs. daily per 1,000 lbs. of live weight for milch cows, 0.5 to 3.3 lbs. per head for young cattle, about 4.5 lbs. for horses, 1 to 1⅗ lbs. per 100 lbs. live weight for sheep, and 1 to 2 lbs. per 100 lbs. live weight for fattening hogs. The influence of the feed on the digestion of the animals as indicated by the appearance of the manure should be noted.—F. W. WOLL.

Fattening steers in winter, T. SHAW (*Minnesota Sta. Bul. 44, pp. 255–279*).

Synopsis.—The principal objects of this test were (1) to compare the value of a light, heavy, and intermediate grain ration, (2) to see if steers could be profitably fattened under existing conditions, (3) to show the importance of not feeding steers too long, and (4) to compare Shorthorn, Hereford, and Galloway breeds.

The existing conditions for fattening cattle in Minnesota are discussed. The test was made with 3 lots of steers, each lot consisting of 1 Galloway, 1 Hereford, and 1 Shorthorn. The lots were given water twice a day, had access to salt, were allowed an hour's exercise in a yard twice a week, and were fed similar rations of grain, corn silage, and hay. The grain mixture consisted of wheat bran, ground wheat and ground corn in the proportion of 1:2:1. During the last period of the test some linseed cake was added. The financial statements are based upon bran at $11, ground wheat at $15.86, silage at $2, hay at $6, and linseed cake at $26 per ton. After a preliminary trial of 7 days to accustom the steers to the feed, the test was begun December 10 and covered 5 periods of 28 days each. The cost of the food of lot 1 during the preliminary experiment was $1.95; of lot 2, $2.07; and of lot 3, $2.15.

At the beginning of the test lot 1 was fed 5 lbs. of grain per head per day; lot 2, 7 lbs.; and lot 3, 9 lbs. These amounts were increased 1 lb. each period. The results are tabulated for each lot and for each breed of steers. The weight of each lot at the beginning of the test, the

food consumed, gains made, and cost of food are shown in the following table:

Food consumed, gains made, and cost of gain per animal for 3 lots of steers.

	Food consumed per day.				Weight at beginning.	Daily gain in weight.	Cost of daily gain.
	Hay.	Grain.	Silage.	Linseed cake.			
	Pounds.	*Pounds.*	*Pounds.*	*Pound.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1	8.73	6.60	24.45	0.44	900.1	1.89	10.31
Lot 2	8.94	8.60	25.00	.44	943.3	1.86	11.84
Lot 3	7.34	10.60	23.38	.44	883.8	2.05	12.62

During the preliminary test the food of the Galloways cost $1.75; of the Herefords, $2.12; and of the Shorthorns, $2.29.

The weight at the beginning of the experiment, the food consumed, gains made, and cost of gain for each breed are shown in the following table:

Food consumed, gains made, and cost of gain per animal for each breed of steers.

	Food consumed per day.				Weight at beginning.	Daily gain in weight	Cost of daily gain.
	Hay.	Grain.	Silage.	Linseed cake.			
	Pounds.	*Pounds.*	*Pounds.*	*Pound.*	*Pounds.*	*Pounds.*	*Pounds.*
Galloways	7.48	8.60	24.25	0.44	804.5	1.89	11.33
Herefords	8.45	8.60	24.75	.44	946.7	2.05	11.67
Shorthorns	9.07	8.60	23.83	.44	976.3	1.85	11.77

At the close of the test the steers were valued at 5½ cts. per pound. The total increase in value of lot 1 was $45.54; of lot 2, $40.83; and of lot 3, $38.61. The increase in value of the Galloways during the experiment was $36.35; of the Herefords, $45.98; and of the Shorthorns, $42.65. The conclusion is reached that large grain rations do not yield proportionally better results than average grain rations.

"The results obtained from feeding the light and heavy meal factors, respectively, would certainly tend to show that when animals are being fattened they will take more meal than they can digest and assimilate to the best advantage even when they do not get 'off their feed.'"

An after test was made from April 29 to June 24. The steers were fed hay and grain. Lot 1 received per head daily 12 lbs. of grain, which included 3 lbs. of linseed cake; lot 2, 14 lbs.; and lot 3, 16 lbs. Until May 6 the grain mixture was the same as during the principal test. From May 6 to May 20 it consisted of wheat bran, ground wheat, and ground corn in the proportion of 1:1:2. After May 20 ground oats was substituted for ground wheat.

The average daily gain per animal of lot 1 was 1.73 lbs.; of lot 2, 1.88 lbs.; and of lot 3, 1.35 lbs. The steers were sold and slaughtered. The average shrinkage in weight per lot during transportation was

$51\frac{5}{9}$ lbs. The amount received for the steers was $585.16, which gave a profit of $82.44. Allowing for shrinkage, there was $20.05 less profit than there would have been if the steers had been sold at the end of the experiment proper.

In the author's opinion the tests show the importance of selling fat animals with promptness. Neither of the breeds tested was markedly superior. The author concludes that it is profitable to fatten cattle under the existing conditions.

Experiments with skim-milk feed, J. LINDSTRÖM (*Norsk Landmansblad, 15 (1896), pp. 155, 156*).—Experiments were made with skim milk as a food for farm animals, and especially for milch cows. The milk was heated to 80 to 85° C. for one-half hour, then cooled to 35 to 40°, and rennet added. While the milk was thickening an equal quantity of chaff or fine cut straw was added; the mixture was stirred and left for 2 to 3 hours; the unabsorbed whey was run off, and the mixture left to ferment for 45 to 48 hours, when it was ready to be fed. As much of the feed is given to milch cows as would equal 4 kg. of milk per head per day. In the author's opinion this amount will amply replace 2 kg. of common mixtures of concentrated feeds (bran, oil cakes, etc).

Several practical feeding tests with this skim-milk feed are given[1] elsewhere.—F. W. WOLL.

Economy of feeding with home-grown wheat and barley, J. A. VOELCKER (*Jour. Roy. Agl. Soc. England, ser. 3, 7 (1896), No. 25, pp. 39–53*).

Synopsis.—Experiments were made with steers and sheep to see whether home-grown wheat and barley could be economically substitued for part of the cake fed in a ration. The conclusion was reached that setting aside the fertilizing value, such a substitution might be advantageously made under the prices then prevailing for wheat and barley.

These experiments were made at the Woburn Experimental Farm in 1894–'95 with steers and sheep. The object was to see if home-grown wheat and barley, which are cheaper, could not partially replace oil cakes. In experiments previously reported[2] home-grown barley and wheat were substituted for all the oil cake in a ration.

Experiments with steers.—Twelve Hereford steers, costing $72.75 per head, were fed in a preliminary period lasting from October 16 until December 10, 1894, a very moderate diet, and just held their own. The experiment proper began December 10. Steers Nos. 1 to 8 were fed in feeding boxes and Nos. 9 to 12 in a covered shed. They were divided into 2 lots. Lot 1, including Nos. 1, 2, 3, 4, 9, and 10, was fed oil cake and no grain, and lot 2, including Nos. 5, 6, 7, 11, and 12, was fed a limited amount of oil cake with grain enough to make a full ration. In addition each lot received Swedes and barley straw *ad libitum*. The steers were

[1] Milch Ztg., 25 (1896), No. 16, pp. 247–248.

[2] Jour. Roy. Agl. Soc. England, 22 (1886), p. 514; 23 (1887), p. 7; 24 (1888), p. 481.

weighed at the beginning and end of the experiment. From the beginning of the experiment until January 6 lot 1 received 4 lbs. of linseed cake and 4 lbs. of decorticated cotton-seed cake, and lot 2 received 2 lbs. each of linseed cake, decorticated cotton-seed cake, and coarsely ground wheat and barley. From January 6 to February 13 the amount of each sort of cake fed to lot 1 was increased to 5 lbs. The cake fed to lot 2 remained the same, but each sort of grain was increased to 3 lbs. From January 13, 4 lbs. of chaff was fed to each animal daily, and early in February mangels were substituted for Swedes. From February 17 until the close of the experiment the cake fed to lot 1 was increased to 6 lbs. of each sort daily. The cake fed to lot 2 remained the same, but each kind of grain was increased to 4 lbs. The steers fed cake drank about 40 lbs. of water daily and the others about 25 lbs. Each lot consumed daily about the same amount of roots (35 lbs.), barley straw (7 lbs.), chaff (4 lbs. hay and 6 lbs. barley), and hay (5 lbs.).

The foods were sampled every week, and from these samples an average sample was taken for analysis each month. The composition of the food is given in tabular form. The financial statements are based on the following prices per ton: Linseed cake at $36 (including $3.50 for transportation and handling), decorticated cotton-seed cake $29.10 (including transportation and handling), wheat at $24, barley at $26 (including expense of grinding in each case), hay at $9.70, barley straw at $4.85, and Swedes at $1.75.

March 6, 3 steers from each lot were fasted one day, then weighed and sold for slaughter. The remaining steers were sold and slaughtered April 3 after fasting one day. The price received for all was 13½ cts. per pound, dressed weight. The average weight at the beginning, the gain in weight, cost of food, profit, and ratio of dressed weight to live weight (fasted) are shown in the following table:

Results of steer-feeding experiment.

	Average weight per animal at beginning.	Average daily gain per animal.	Average cost of food per animal.	Profit per head.	Ratio of dressed weight to live weight (fasted).
	Pounds.	*Pounds.*			*Per cent.*
Lot 1 (cake):					
Sold March 4	1,063	1.8	$19.71	$1.35	58.4
Sold April 1		1.6			
Lot 2 (cake and grain):					
Sold March 4	1,066	1.8	$17.59	$5.14	58.4
Sold April 1		1.8			

The following conclusions were reached: "At the prices of the respective foods the feeding with grain proved a decided economy, so far as the mere increase of weight in the cattle was concerned. On the other hand, there is to set against this the superiority of the manure produced by cake-feeding." Under the then existing financial conditions the author believes that, taking into account the fertilizing value

of the food, "it is not material whether all cake be used with roots and chaff, or whether the cake be in large measure replaced by wheat and barley. . .

"Another point brought out by the experiment is that the feeding of bullocks under the conditions of prices ruling for food and for meat, as set out in the experiment, is not profitable, and were it not for the manure produced would practically result in loss."

Experiments with sheep.—Sixty Hampshire Down sheep with a slight trace of "Oxford" were purchased August 24, 1894, for $9.87 per head. The experiment was begun December 13, after a preliminary period on grass and later on turnips to accustom them to root feeding. The sheep were then considered worth $10.50 per head. They were divided into 3 lots of 20 animals each. Lot 1 was fed 0.5 lb. linseed cake, lot 2 0.25 lb. linseed cake and 0.25 lb. whole wheat, and lot 3 0.25 lb. linseed cake and 0.25 lb. whole barley per animal daily. In addition all received hay chaff and roots *ad libitum;* at first mangels, then part Swedes, and finally all Swedes. From January 6, 1895, to February 17 the cake fed lot 1 was increased to 0.75 lb., and from January 6 to January 24 the grain fed to lots 2 and 3 was increased to 0.5 lb. The sheep did not do well, and the ration was changed so that each animal received $\frac{3}{8}$ lb. of cake and the same amount of grain. From February 17 until the close of the experiment the cake fed lot 1 was increased to 1 lb. and the cake and grain fed to lots 2 and 3 were each increased to 0.5 lb. It was found that the sheep consumed per head daily from 18 to 20 lbs. of roots and 0.5 lb. of hay chaff. One sheep in lot 1 died and 1 in lot 3 was sick and was dropped from the experiment.

The financial statement is based on the same values as in the experiment with steers, except in the case of grain. Since it was fed unground, wheat is taken at $21.65 and barley at $24.25 per ton. The composition of the food was determined from the analyses referred to in the experiments with steers.

On February 26 10 sheep from each lot, and on March 4 the remainder, were made to fast for one day, then weighed, and sold for slaughtering at 19 cts. per pound. The dressed weight was also taken.

The average weight at the beginning, cost of food, gain in weight, and profit per head are given in the following table.

Results of sheep-feeding experiments.

	Average weight per animal at beginning.	Average gain per animal.	Average cost of food per animal.	Profit per animal.	Ratio of dressed weight to live weight (fasting).
	Pounds.	*Pounds.*			*Per cent.*
Lot 1 (linseed cake)	108.20	32.0	$2.14	$1.35	53.4
Lot 2 (linseed cake and wheat)	108.25	31.5	1.92	1.22	52.6
Lot 3 (linseed cake and barley)	108.30	33.7	1.96	1.67	53.4

The following conclusions were reached: "So far as the actual feeding was concerned, and leaving out of account for the time the manurial values of the foods, the best feeding return was given by the mixture of linseed cake and barley in approximately equal quantities, while the least satisfactory return accrued from the use of linseed cake and wheat in approximately equal proportions." Under the then existing conditions the author believes that "when both feeding and manurial results were taken into consideration, [there was] a slight advantage of about 18 cts. per head in favor of feeding with linseed cake and barley in equal quantities as against the same total in the form of linseed cake alone. . . .

"A further point brought out in this series of experiments is the decidedly more favorable return derived from sheep feeding as compared with bullock feeding."

On an experiment in calf feeding, A. GOUIN (*Jour. Agr. Prat., 60* (*1896*), *I, No. 26, p. 931*).—The author gives a brief account and criticism of some experiments on calf feeding made at the École Pratique d'Agriculture de Saint-Bon. Nine calves from 3 to 6 months old were divided into 3 lots of 3 each, the average weight in lot 1 being 226 kg., in lot 2, 187 kg., and in lot 3, 145 kg. All were fed a ration of 1 kg. of hay, 5 kg. of beets, and 500 gm. of rye per 100 kg. live weight. In addition, lots 1 and 3 were fed 250 gm. of rape-seed cake and lot 2 500 gm. of bran. The experiment continued 70 days. Lot 1 gained 26 per cent of their initial weight, and lots 2 and 3 gained 29 per cent.

The conclusion was reached by the experimenters that while the percentage gain was practically the same, there was an advantage in using rape-seed cake where its cost was not more than double that of bran. The author criticises the method of calculation followed in the Saint-Bon experiments. He believes that more trustworthy results are obtained by computing the gains per day rather than the total percentage gain.

Fattening lambs in winter, T. SHAW (*Minnesota Sta. Bul. 44, pp. 280–295*).

Synopsis.—A feeding test was made (1) to determine the relative value of fattening lambs in yards, in sheds with access to yards, and confined in sheds; (2) to compare a limited and an *ad libitum* grain ration; (3) to determine the relative value of wheat screenings and oil cake and wheat and oil cake as a grain ration, and (4) to see if lambs can be profitably fattened under the prevailing conditions.

The test, which began November 19 and continued 117 days, was made with 30 wether and 10 ewe lambs, averaging $76\frac{1}{4}$ lbs. The lambs were grade Shropshires and purchased in the neighborhood. They were divided into 5 uniform lots containing 6 wethers and 2 ewes. Lot 1 was kept in a yard on the sunny side of a building. Lots 2, 3, and 4 were fed indoors, but were allowed to run in a yard. Lot 5 was confined in a barn. The lots were fed all the hay they would eat without waste. Lots 1, 2, 3, and 5 were fed in addition wheat screenings and oil cake in the proportion of 9 to 1 and lot 4 wheat and oil cake in the same proportion. The lambs were fed twice a day. Lots 1, 3, 4,

and 5 were fed all the grain they would eat up clean, and lot 2 was fed with a self feeder. The lambs had free access to salt. The financial statements are based on hay at $6, wheat screenings at $9, oil cake at $26 per ton, and wheat at 47.6 cts. per bushel.

In a preliminary test, which lasted from October 29 to the beginning of the test proper and was made under the same conditions, the lambs consumed 644 lbs. of hay, 909 lbs. of screenings, 192 lbs. of wheat, and 122 lbs. of oil cake. From the time of arrival at the station until the beginning of the preliminary test the lambs were pastured and given some food in addition. The total cost was estimated at $3.

The feeding experiment was divided into 4 periods of about a month each. Tables are given which show the food consumed during each period. The average amount of food consumed per animal daily during the whole test, the gain made, and cost of gain are shown in the following table:

Food consumed, gain in weight, and cost of gain by lambs.

	Food consumed per day.				Weight at beginning.	Daily gain.	Cost of 1 pound of gain.
	Hay.	Screenings.	Wheat.	Oil cake.			
	Pound.	*Pounds.*	*Pounds.*	*Pound.*	*Pounds.*	*Pound.*	*Cents.*
Lot 1	0.887	1.824	....	0.251	79.750	0.280	5.36
Lot 2	.462	2.907	....	.322	83.875	.356	5.25
Lot 3	.805	2.140	....	.237	78.000	.321	4.71
Lot 4	.825	....	1.684	.188	79.500	.297	6.48
Lot 5	.803	2.049	....	.226	77.625	.284	5.41

The lambs were sold in Chicago for $269.40, yielding a profit of $24.79. The average shrinkage in weight per animal during transportation was 3.5 lbs.

Among the conclusions drawn from the test are the following:

"The average gain made by the lambs in this experiment was 9.22 lbs. per month, and without any succulent food, as, for instance, silage or field roots. . . .

"Lambs do not gain so rapidly in cold weather as when the temperature is moderate, notwithstanding the greater consumption of food.

"The greatest profit was obtained from the lambs which were fed a limited grain ration of wheat screenings and oil cake, and which were allowed liberty of access to shelter at will; next to these come the lambs fed under cover; and the least profit arose from the lambs to which wheat and oil cake were fed. . . .

"Prompt marketing as soon as good gains cease to be made is important. . . .

"A grain ration of wheat and oil cake, though well adapted to short periods of feeding, is not well adapted to prolonged periods. Oil cake is a more suitable grain food for lengthened periods of feeding.

"Any one of the methods adopted in fattening lambs may be expected to succeed at least fairly well when due attention is given to the work."

Results of feeding beet leaves, N. ZUNTZ (*Chem. Ztg.*, *20* (*1896*), *No. 52*, *p. 513*).—At a meeting of the Union for Beet-Sugar Industry in the German Empire the following report was made on experiments on the above subject:

The investigation was limited to a study of the poisonous properties

of oxalic acid, which forms as much as 10 per cent of the dry matter of beet leaves. The opinion was held that oxalic acid in food caused a deficit of calcium in the system. This might be avoided by neutralizing the food with calcium carbonate. The author made experiments with a sheep and with swine. The sheep was not affected by the oxalic acid in the food. The bones were normal. In the author's opinion sheep are not injured by oxalic acid, because it is destroyed by a special and very active fermentation in the first stomach. Swine were much more susceptible to the action of oxalic acid. One died from a lack of calcium in the bones. The hydrochloric acid extract of the feces of the swine fed with beet leaves contained large quantities of calcium salts, while that from animals not fed beet leaves contained very little.

The author recommends beet leaves as a desirable and safe food (for sheep?). Too much should not be fed at first, and calcium carbonate may with advantage be added to the food. This may be omitted later. Cured beet leaves are eaten readily and agree with animals very well. The diarrhea which is observed when the green leaves are first fed is not noticed with the dry leaves. Still, in the author's opinion, it is hardly profitable to dry the leaves.

Quarantine experiments with swine, J. Arup (*Tidskr. Landökon., 14 (1895), pp. 502–521*).—The German quarantine regulations concerning importations of swine from Denmark caused a fear in the latter country that export trade might seriously suffer. It was thought that there might be a loss in weight, a deterioration in the quality of the pork, or a loss from disease or death, incident to the 10-day quarantine period. To investigate the question 36 hogs were divided into 3 lots of 12, 14, and 10 animals, respectively, and sent to Copenhagen. Half the animals in each lot were slaughtered at the beginning of the trial. The remainder were kept under quarantine conditions and were fed 5 lbs. of barley per head daily for 10 days, when they were slaughtered. The quality of the pork was carefully determined in every case. It was necessary to slaughter half the remaining animals in lot 3 before the end of the trial, as they were found to be suffering from carbuncular erysipelas. They are therefore not included in the averages. The following table shows the average weights of the different lots, the gains made, and the dressed weight of the animals:

Results of slaughtering tests.

	Slaughtered at beginning of quarantine.			Slaughtered at end of quarantine.		
	Average live weight.	Average dressed weight.	Per cent dressed weight.	Average live weight.	Average dressed weight.	Per cent dressed weight.
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*	*Per cent.*
Lot 1	328.7	266.5	80.8	341.9	289.1	84.5
Lot 2	327.6	261.8	79.9	386.7	325.6	84.3
Lot 3	343.6	286.2	82.3	....	....	....

The live weights given in the table refer to the weight at the shipping point. All the animals included in the experiment gained in live weight during the feeding period, and examination showed that the quality of the pork did not suffer.

The reason for exportation of as heavy hogs as those included in the experiment lies in the present German tariff, which imposes a custom duty of 5 marks per head for live hogs, while the tariff on slaughtered hogs is 17 marks per 220 lbs.—F. W. WOLL.

Areca and betel, E. MARTIN (*Rev. Scient., ser. 4, 6 (1896), No. 4, pp. 112–117*).—A description of areca and betel, with their properties and uses.

Proximate composition of the gluten cf cereals, E. FLEURENT (*Compt. Rend., 123 (1896), No. 5, pp. 327–330*).

Chemical study of low-grade flour used in baking, BALLAND (*Compt. Rend., 123 (1896), No. 5, pp. 325–327*).

The food required by children of various ages, W. CAMERER (*Ztschr. Biol., 35 (1896), No. 3, pp. 320–332*).—A criticism of work on this subject by Sondén and Tigerstedt.

On the lowest limit of nitrogen equilibrium, E. VOIT (*Ztschr. Biol., 33 (1896), No. 3, pp. 333–351*).—A reply to Munk's criticism on this subject.

Digestive proteolysis, R. H. CHITTENDEN (*New Haven: Little, Morehouse & Co., 1895, pp. 137*).—The book consists of the Cartwright lectures for 1894, printed originally in the Medical Record. The subjects treated of are as follows: The general nature of protelytic enzymes and of proteids, proteolysis by pepsin hydrochloric acid, with a consideration of the general nature of proteoses and peptones, proteolysis of trypsin, and absorption of the main products of proteolysis.

An extension of the application of the law of equivalence of energy in biology, A. CHAUVEAU (*Compt. Rend., 123 (1896), No. 5, pp. 283–289*).

The normal occurrence of iodin in the animal body, I, E. BAUMANN (*Ztschr. physiol. Chem., 21 (1896), No. 4, pp. 319–330*).

The normal occurrence of iodin in the animal body, II, E. BAUMANN and E. ROSS (*Ztschr. physiol. Chem., 21 (1896), No. 5–6, pp. 481–493*).

The normal occurrence of iodin in the animal body: III. The iodin content of the thyroid gland of man and animals, E. BAUMANN (*Ztschr. physiol. Chem., 22 (1896), No. 1, pp. 1–18*).

Fattening or turning loose in the pasture, H. BARTH (*Deut. landw. Presse, 23 (1896), No. 76, p. 681*).—The advantages and disadvantages of both procedures are discussed.

DAIRY FARMING—DAIRYING.

The effect of heavy exercise on milk production, T. HENKEL (*Landw. Vers. Stat., 46 (1895), pp. 329–355*).—The literature of this subject is reviewed at length, and is summed up by the author as follows:

"The authors agree that moderate exercise has a favorable influence on the quantity and quality of milk, while heavy fatiguing exercise or work diminishes both the quantity and the quality of the milk. But as to the effect of heavy exercise on the quality of milk the results are not clear or uniform."

Seven separate experiments are reported in which cows—usually a

number—were driven a considerable distance, in some cases up a mountain, and the milk analyzed for a number of days before and after the trip. These experiments were made on different cows, in different parts of the country, and under varying conditions. They all showed that heavy exercise influenced both the quantity and quality of milk. The quantity of milk diminished and also the absolute amount of milk constituents. This decrease was more or less noticeable in the first milking after the trip, according to the severity of the exercise, and was much more noticeable in the second milking. The water content decreased in the first milking and more in the second milking, then gradually returned to the normal. The casein content increased in the first milking, remained about the same in the second milking, and then gradually sunk to the normal. The fat content was much increased in the first milking, according to the severity of the trip, was still larger in the second milking, and then gradually sunk to the normal. The sugar content decreased in the first milking and usually rose again to the normal in the second and following milkings. The ash content was noticeably higher in the first milking after the trip, and then sunk to the normal. The acidity was not greater after than before the exercise, as has been claimed. In no case did the milk curdle on heating.

Three experiments were also made with goats, in two of which the goats drew a load part of the way. As in the case of the cows, the sugar content decreased considerably, and the fat content (probably also the casein and ash) increased noticeably in the first milking after the exercise. But in the case of the goats, the milk of the second milking was nearly normal in composition, only the sugar being below normal, and the increase in fat content did not continue in the second milking.

Danish feeding experiments with milch cows, 1887–'95, F. FRIIS (*34th Rpt. Kgl. Vet. and Landbohöjsk. Lab. landök. Forsög, Copenhagen, 1895, pp. 96*).—The report gives a summary of all cooperative feeding experiments with milch cows conducted by the Danish State Experiment Station since 1887 (E. S. R., 4, pp. 601-606; 6, pp. 588, 589, 657–659), and in addition the results are given of the series of experiments carried on during the winter of 1894–'95. In the latter a grain mixture of barley and oats was compared with wheat on 6 different estates on the same general plan as earlier experiments. In each case the cows were divided into 3 lots. All were fed about 3.3 lbs. of wheat bran, 1.8 lbs. of oil cake, 30 lbs. of mangel-wurzels, and 10 lbs. of hay per head, and straw *ad libitum*. In addition lot A was fed on an average 5.2 lbs. of the grain mixture, lot B 2.6 lbs. of the same and 2.6 lbs. of wheat, and lot C 5.2 lbs. of wheat. During the preliminary and post experimental periods all the cows were fed the same rations as that fed to lot A throughout the experiment. The average results follow (p. 256).

Average yield and fat content of milk.

	Yield of milk per day.			Fat in milk.		
	Lot A. Grain mixture.	Lot B. ½ grain mixture, ½ wheat.	Lot C. Wheat.	Lot A. Grain mixture.	Lot B. ½ grain mixture, ½ wheat.	Lot C. Wheat.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*
Preliminary period	26.3	26.3	26.4	3.08	3.11	3.11
Experimental period	23.0	22.8	23.2	3.09	3.10	3.12
Post-experimental period	21.0	21.1	22.0	3.24	3.25	3.29

The yields of milk of the different lots were practically the same throughout the experiment, except in case of lot C during the post-experimental period. This latter may have been due to an unevenness in the lots which had not previously shown itself. No differences were found in the average fat content of the milk of the cows in the different lots. The changes in live weight were on the average slightly in favor of the wheat feeding, though the results are not uniform.

The conclusion is drawn that, "judging from these experiments, wheat and a mixture of barley and oats must be considered of very nearly equal value as food for milch cows."

Influence of feed on quality of milk.—The experiments with milch cows conducted at this station, as previously stated, lead to the conclusion that the average fat content of the milk produced was not practically changed by changes in the composition and the quantities of the rations fed, although the changes were radical. In all cases the rations were ample. "There was an appreciable and very characteristic influence of the feed on the quality of the milk when the cows were turned to pasture in the spring. Calculated from the average of the last 10 days in the stable and the first 10 days at pasture, the fat content of the milk increased on pasturage sometimes as much as 1 per cent for single cows, and occasionally 0.5 per cent for single lots. But this increase in the fat content always rapidly disappeared, and could usually not be traced beyond a few weeks."

[The food is only one of the points of difference between the two feeding periods. The exercise in open air, the full supply of fresh air and sunshine when the cows are on pasture are other and, it would seem, more important factors. In other words, the difference observed in the quality of the milk may be explained by the influence of the new conditions on the nervous system of the cows, rather than by the effect of the food on the milk secretion.—F. W. W.]

The relation between the amount of food eaten, the yield and the fat content of the milk, and the yield of butter has been calculated from all the results obtained at the station in feeding experiments with milch cows. The amount of food is expressed in "food units," calculated from the average rations fed at the different estates according to the following ratios: 1 food unit = 1 lb. concentrated feed (grain, bran, oil cakes) = 10 lbs. mangel-wurzels = 12½ lbs. turnips = 2 lbs. hay = 4

lbs. straw. The yields of butter are calculated from the average yields of butter fat by means of the following formula (Fjord's): Yield of butter per 100 lbs. of milk = (per cent fat − 0.22) $\times \frac{100}{86}$.

The average results per cow daily are as follows:

Average relation between amount of food and yield of milk and butter.

No.	Name of estate.	Number of food units.	Fat content of milk.	Yield of milk.	Yield of butter.
			Per cent.	*Pounds.*	*Pound.*
1	Rosvang	18.9	3.18	25.3	0.870
2	Wedellsborg	18.4	3.29	22.9	.818
3	Ourupgaard	17.8	3.15	25.0	.853
4	Sdr. Elkjaer	17.6	3.17	23.6	.809
5	Nislevgaard	16.5	3.18	21.0	.722
6	Soeholt	16.3	3.31	21.1	.757
7	Kjaersgaard	15.8	3.28	19.5	.794
8	Bregentved	15.6	3.12	21.8	.735
9	Sanderumgaard	14.7	3.24	19.6	.688
	Averages:				
	1 to 3	18.4	3.21	24.4	.847
	4 to 6	16.8	3.22	21.9	.763
	7 to 9	15.4	3.21	20.3	.739

The data for the percentages of fat do not appear to bear any relation to the intensity of feeding. The yields of milk and butter rise and fall very regularly with the number of food units fed. This is especially apparent from the average data for each group of three.

Composition of Danish milk.—In the following table will be found the average composition of the milk produced on the nine Danish estates mentioned in the above table:

Average chemical composition of milk produced on Danish estates.

No. of estate.	Number of years included.	Days from calving—At beginning of experiments.	Days from calving—At end of experiments.	Composition of milk.—Water.	Composition of milk.—Fat.	Composition of milk.—Nitrogenous substances.	Composition of milk.—Milk sugar.	Composition of milk.—Ash.	Production per cow per day.—Milk.	Production per cow per day.—Butter.
				Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Lbs.*	*Lb.*
I	8	37	213	88.05	3.18	3.10	4.90	0.77	25.3	0.870
II	8	64	253	87.92	3.29	3.13	4.88	.78	22.9	.818
III	3	51	204	88.11	3.15	3.17	4.80	.77	25.0	.853
IV	7	45	204	87.94	3.17	3.20	4.90	.79	23.6	.809
V	5	42	222	88.13	3.18	3.09	4.82	.78	21.0	.722
VI	3	55	205	87.99	3.31	3.12	4.81	.77	21.1	.757
VII	6	50	233	88.01	3.28	3.10	4.85	.76	19.5	.794
VIII	7	50	220	88.25	3.12	3.01	4.85	.77	21.8	.735
IX	8	51	221	88.12	3.24	3.02	4.85	.77	19.6	.688

All experiments conducted since 1887 are included in the summary. The determinations made show but small variations in the milk produced on the same estates from year to year. All experiments were conducted during the winter, in the majority of cases between November and June.

The average composition is also given of the various feeding stuffs used in this coöperative experiment.—F. W. WOLL.

Spayed cows at the Geneva Exhibition, C. CORNEVIN (*Jour. Agr. Prat., 60 (1896), II, No. 31, pp. 164–167*).—The cow referred to in the following account received the first prize at the Geneva Exhibition. The operation of spaying was performed January 17, 1895. The animal was slaughtered May 12, 1896. The weight at the time of spaying was 735 kg. and at the time of slaughtering 928 kg., the average daily gain being 0.4 kg. The yield of milk gradually diminished for about 4 months after the operation, and then remained nearly constant for the remaining 12 months of the period under consideration, the average daily yield being 11.7 liters. The cow consumed during the period 5,178 kg. of hay and rowen, 847 kg. of linseed cake, 662 kg. of maize, 400 kg. of wheat, 1,245 kg. of potatoes, 266 kg. of middlings, 858 kg. of beets, 339 kg. of bran, and 62 kg. of barley. The weight of the carcass and organs is given. The article contains a review of the subject by R. Gouin.

Effect of lead acetate on milk, BAUM and SELIGER (*Arch. Thierheilk.; abs. in Ztschr. Nahr. Untersuch. und Hyg. Waarenk., 10 (1896), No. 6, p. 114*).—A goat was fed for nearly 14 days 1 to 1.5 gm. of lead acetate per day. During the first 3 days only traces of lead were present in the milk, but subsequently 0.0009 to 0.0013 per cent of lead; and this amount continued after the administration of lead ceased. A young cat and a small dog fed with the milk showed no symptoms of illness.

A cow was given 3 gm. of lead acetate daily for 3 weeks, 4 gm. for 8 days, 5 gm. for 14 days, and up to 9 gm. for 25 days, receiving at length 15 gm., making in all 520 gm. during 80 days. There was no injury to health from this. When the dose reached 10 to 12 gm. 0.0015 to 0.02 per cent of lead was found in the milk.

Two young cats and dogs fed the milk for 10 weeks showed no ill effects whatever. On slaughtering the cow, considerable percentages of lead were found in various parts of the carcass. The author concludes that the milk of cows treated with the lead acetate is harmless for man or animals.

The milk of tuberculous animals, means of rendering it harmless, and its use, ZÜRN (*Molk. Ztg., 10 (1896), No. 12, pp. 181–183*).—The author discusses the literature on the prevalence and dangers of milk from tuberculous cows, the means which have been suggested for rendering such milk harmless, the statutory measures adopted in some countries against tuberculous animals, and the sale of their meat and milk, etc. The wholesale testing of cows with tuberculin he believes to be impracticable, chiefly on account of the expense. He argues against compulsory heating or sterilizing of all milk before it is sold, on the ground that the public generally demands raw milk, the operation can not be controlled so as to insure its being properly carried out in all cases, and such milk is more difficult to digest if not less digestible, and concludes that this can not rightfully be required of the milk dealers. He believes the only practicable way in which to do away

with the danger is to educate the people to use only milk which they have themselves pasteurized or sterilized.

In conclusion, he states Dr. Law's views in regard to the dangers from consuming the meat and milk of tuberculous animals, which he criticises.

The present status of bacteriological investigation in dairying, H. WEIGMANN (*Milch Ztg., 25 (1896), Nos. 10, pp. 147–150; 11, pp. 163–166*).—This is a lecture delivered before the German Dairy Union. The progress in dairy bacteriology during the past 5 years is reviewed in a general way. The origin of the bacteria in milk, sources of contamination, relation of food and of cleanliness in the stable to contamination, milk and butter "faults," the use of pure cultures for ripening cream, sterilizing and pasteurizing milk, and the ripening of cheese are treated at greater or less length.

After summing up the work on the ripening of cream and the employment of pure cultures of different kinds, the author says: "It will be seen that the effort is to produce artificially, not only pure butter of good keeping quality, but also butter of delicate aroma; and that it is only a question of time when mixed cultures will be widely used in place of cultures of acidifying bacteria alone. But for the present it is to be wished that we might more generally follow the example of Denmark, and by taking advantage of the improved methods of butter-making produce a pure and fine-flavored butter, which is possible with the use of pure cultures of souring bacteria."

The spontaneous souring of milk, G. LEICHMANN (*Milch Ztg., 25 (1896), No. 5, pp. 67–70*).—The author refers to a previous paper by himself and to a recent one by C. Günther and H. Thierfelder (E. S. R., 7, p. 806). In his previous studies on 24 samples of milk of various origin, made during summer, the souring was determined to be invariably due to a single form of microörganism which did not agree with Hueppe's *Bacillus acidi lactici* or with other described forms. The form found by Günther and Thierfelder is said to correspond to that found by the author, although they pronounced it identical with *Bacillus acidi lactici.* The author gives a preliminary account of continued studies during winter on some 60 samples of milk from different localities. The same lactic-acid bacillus as previously described was found in all the samples, and in nearly all in such immense numbers as to convince the author that it was the cause of the souring. In sterilized milk it produced optically active, dextro rotatory lactic acid, with traces of a volatile compound giving the iodoform reaction, but no volatile acids or gas formation. A pure culture in milk in a breeding oven for 3 days used 0.65 per cent of the milk sugar present, and the increased acidity was equivalent to 0.67 per cent of lactic acid. As no other acid was produced, it is believed that the decomposition of the milk sugar by the bacillus was as Schützenberger has suggested:

$$C_{12}H_{22}O_{11}+H_2O=4C_3H_6O_3.$$

Oxygen was not necessary to the fermentation. The effect of different temperatures was studied in detail. Although at lower and middle temperatures the bacillus behaved like spontaneously souring milk, at higher temperatures (above 45° C.) it differed perceptibly. It was found that the spontaneous souring between 44 and 50° C. was a lactic fermentation, but was caused by a different organism from the one causing the ordinary spontaneous souring. The author concludes that there are two well-characterized mocroörganisms concerned. Sometimes one of these predominates and sometimes the other. The most common of these is a micrococcus, the other a bacillus. Both thrive only at a high temperature, but are very different on agar plates. In other respects they appear to be alike. They cause exactly the same curdling of sterilized milk as the bacteria causing the common spontaneous souring, although they act only at higher temperatures—at 33 to 35° C., relatively slowly, but rapidly at 40 to 48°. The product of their action is the same as the common form, except that the micrococcus produces right-handed lactic acid, while the bacillus produces the left-handed acid.

With regard to the occurrence of the ordinary bacillus of the spontaneous souring of milk, the author found it regularly in dust, provided this had not laid too long in a dry place. It was frequently found on hay and straw, but not in cow dung or tap water. It was found to be an active element in the pure cultures purchased at the Kiel Station for souring cream and in Hansen's preparation.

Creaming experiments, F. B. LINFIELD (*Utah Sta. Bul. 42, pp. 15*).—In these experiments, which covered nearly a year, comparisons were made between separating the cream with a hand separator and creaming in shallow pans and in deep cans of the Boyd Cooley, Shotgun, Common Sense, and Vermont Cooley patterns. The Common Sense can is like the Shotgun, except that the skim milk is drawn from the bottom of the can. The results with each method of creaming are tabulated and summarized. Taking the averages for the whole year, the percentages of fat in the skim milk with the different methods were as follows: Shallow pan 0.35, Boyd Cooley deep can 0.70, Shotgun pail 0.65, Common Sense pail 0.70, Vermont Cooley can 0.70, and separator 0.10.

A number of tests of the skim milk from farms where deep and shallow pans were used for skimming indicated that the above results "are not exceptional, but rather better than many people are doing."

Six tests were made during the fall and winter months of setting the milk in deep cans in ice water or in the air. In September setting in ice water gave much the best results, but in the winter months there was naturally less difference.

The author makes the following practical deductions from his experiments:

"(1) As regards thoroughness of skimming, the effectiveness of the methods of creaming milk, according to our work, stands in the following order: 1st, separator; 2d, shallow pans; 3d, deep pails.

"(2) When the setting methods are practiced, the pans will give much the best results during the winter or cold months.

"(3) There is no advantage, but rather the opposite, in moving the pans into the house during the cold weather, provided that they be kept in a place where the milk will not freeze.

"(4) Of the deep setting cans, those which are skimmed by drawing the skim milk from the bottom give the better results; but the Cooley or submerged can, as regards thoroughness of skimming, does not seem to possess any advantage over those not submerged.

"(5) From the results given it is evident that for a herd of 10 good cows a separator would be a wise investment. The extra butter obtained by its use, valued at 20 cts. a pound, would pay 20 per cent a year on its cost as compared with results from shallow pans, and 50 per cent a year as compared with deep setting.

"(6) With the deep setting methods, the cooler the water is kept in which the milk is set the better the skimming. In fact, to do the best skimming it is absolutely necessary to use ice, and a sufficient quantity of it to keep the water at 40° F. or below, at all times."

The Conn culture (B41) in butter making, E. H. FARRINGTON and H. L. RUSSELL (*Wisconsin Sta. Bul. 48, pp. 22*).—This bulletin describes numerous experiments with the use of Conn's "B41" culture in ripening separator cream at 50 to 60° and 60 to 70° F., and also in ripening gathered cream from a creamery in the State. In every experiment the cream was divided into 2 lots—one being ripened with the B41 and the other allowed to ripen without the aid of any starter.

Usually a bacteriological examination was made of the culture pellet as it came from the company.

"In all, 10 different samples of this culture have been examined bacteriologically.

"As a rule, the cultures received were quite uniform in their character. When examined bacteriologically by means of culture plates, the purity of the starter as determined by the percentage of germs belonging to 'B41' usually varied from 97 to 99 per cent. Associated with the proper organism there was in every case another species that liquefied gelatin and had a digesting action on milk. This impurity was present in all samples, although in only a small degree, varying from 1 to 2 per cent of total germ life in sample selected. In several instances, other species of bacteria appeared in the plates."

In a number of cases a bacteriological examination was made of the cream after the B41 had been added, and also after the cream had ripened for some time.

"These examinations showed that the percentage of 'B41' bacteria in the cream was subject to great fluctuation. In some cases this organism made up only about 3 per cent of the total number of bacteria that were present in sweet cream immediately after adding the culture starter; then again, 'B41' was present to the extent of 15 per cent of total bacteria.

"In a number of cultures made from the cream ripened with the aid of the 'B41' starter, this culture organism was invariably found, although the percentage varied greatly as before. The germ seems to be a thrifty one, and apparently is not killed out in competition with the lactic acid bacteria universally present in milk."

In each experiment the 2 lots of cream were allowed to ripen for the same length of time and were usually churned at the same time. As the B41 almost invariably hastened the development of acid it was necessary to hold this cream at a somewhat lower temperature than

that without starter. The butter from both lots was treated exactly alike and was packed on the day succeeding the churning and shipped immediately to a number of well-known dairy experts for scoring.

Eleven trials were made with separator cream ripened for about 2 days at from 50 to 60° F.

"The average of the scores of each kind of butter as scored on basis of 50 as perfect flavor by the different judges is summarized as follows:

Butter from separator cream ripened 2 days at 50 to 60° F.

	Gurler.	Barber.	Woolverton.	General average score.[1]
Number of butter packages scored	14.0	22.0	10.0	....
Average score of normal butter	47.0	47.3	44.2	46.9
Average score of B41 butter	45.6	46.4	44.6	45.8
Difference in favor of normal butter	1.4	0.9	—0.4	1.1

[1] This score is obtained by averaging the total number of points scored and not averaging the averages of each judge.

"Seven of the 11 lots were scored by Gurler and in no instance did he score the 'B41' higher than the normal butter; in 4 cases it scored several points lower.

"All the 11 lots were scored by Barber and the 'B41' was likewise in no case better than the normal butter.

"Woolverton scored the 'B41' butter higher than the normal butter in 3 of the 5 lots of chilled butter which he tested. His scores are almost uniformly lower than those of the other two judges. This is due to the fact that the butter aroma was only faintly, if at all, perceptible when he scored the butter."

Four trials were made with separator cream ripened for about 1 day at 60 to 70° F.

"In the 32 scores made by the 4 judges on the 8 different packages of butter the 'B41' product scores lower than normal 10 times, higher than normal 3 times, 3 times the same.

"The average of the scores of each kind of butter is indicated below:

Butter from separator cream ripened 1 day at 60 to 70° F.

	Gurler.	Barber.	Moore.	Douglas.	Woolverton.	General average score.
Number of butter packages scored	8.0	8.0	8.0	8.0	4.0	....
Average score of normal butter	45.9	45.5	44.5	46.4	45.0	45.5
Average score of B41 butter	41.6	43.7	42.6	42.4	44.5	42.7
Difference in favor of normal butter	4.3	1.8	1.9	4.0	0.5	2.8

Seven trials were made with gathered cream.

"In the 40 scores made by 3 different judges on the above 14 packages of butter the 'B41' butter scored lower than normal 14 times, higher than normal 2 times, and twice the same. While the difference was not great with the exception of one instance, yet the uniformity can leave no doubt as to the relative quality of the two kinds of butter.

"Averaging the scores of each judge on the different kinds of butter gives the following figures:

Butter from gathered cream.

	Gurler.	Barber.	Moore.	General average scores.
Number of butter packages scored	14.0	14.0	12.0	....
Average score of normal butter	44.4	45.3	45.1	45.3
Average score of B41 butter	43.7	44.0	43.0	43.9
Difference in favor of normal butter	0.7	1.3	2.1	1.4

"A comparison of the foregoing scores shows that the fresh butter from the separator cream ripened about 2 days was the best. In nearly every one of the 11 trials such butter scored from 46 to 48 on flavor. The 4 trials of separator cream ripened for about 1 day at a higher temperature, with few exceptions, scored lower than the butter from cream ripened for a longer time at a lower temperature, although the number of experiments made was not sufficient to determine this point definitely. Some of the scores of the gathered cream butter are as high as those of the best separator butter, but usually they are lower. This shows that it is possible to make as good butter from gathered as from separator cream.

"It should be said that during the interim between the different experiments the Conn culture was used in the sweet cream from day to day. In these cases the cream was not divided, but the quality of the butter compared with our usual product was noted.

"While in the main no appreciable difference was observed between the cultured and the normal butter, yet occasionally the product did not seem to be up to the usual standard of the creamery. These regular churnings far outnumbered the experimental ones, but as they were not checked by duplicate lots of cream ripened without any starter, their evidence is not so strong as in the case of the regular experiments described in this bulletin. However, they substantiate these experiments and add further data that point to the same conclusion that the 'B41' culture failed to improve the quality of the butter as compared with that made from normally ripened cream."

To test the effect of the use of B41 on the keeping quality of the butter, all of the butter that was sent to one of the scorers (A. H. Barber, a leading commission merchant of Chicago) was placed in cold storage after being scored by him. The date at which the butter was placed in cold storage is not given in the bulletin. On November 18 all the packages were removed from storage, allowed to stand at room temperature for 2 days, and again scored by Mr. Barber on the basis of cold-storage goods. A week later the same samples were scored by Mr. Woolverton on the same basis. A summary of these scores compared with the scoring of the fresh butter is given.

"The result of 11 experiments with separator cream ripened for 2 days may be grouped as follows:

"In 6 experiments 'B41' scored a total of 21½ points above normal.

"In 4 experiments 'B41' scored a total of 10 points below normal.

"In 1 experiment 'B41' scored the same as normal butter. . . .

"There was little difference (2 points) between the sum of the scores of the 'B41' and normal butter when both were taken from storage, but as the fresh normal butter scored 9½ points higher than the fresh 'B41' butter the loss of flavor by storage

is 11½ points more for the normal than for the 'B41' butter. This agrees with the generally accepted opinion that the highest flavored butter loses most in storage.

"Seven experiments were made with 'B41' in gathered cream. In 5 experiments 'B41' scored a total of 8.5 points below normal, in 2 experiments 'B41' scored a total of 3 points above normal. . . .

"Relative difference [in favor of] normal butter when fresh, 6 points.

"Relative difference [in favor of] normal butter after storage, 11.5 points. The normal [from gathered cream] kept, therefore, better than the 'B41' product.

"Inasmuch as the butter made from separator cream ripened at high temperatures for about 1 day was not in storage for more than a few days, no conclusions as to the keeping quality of the same under these conditions can be made."

In the above the butter from separator cream scored on a basis of perfect flavor 550 points and that from gathered cream 350 points. The scorings of the fresh butter made by different judges are grouped so as to show the relative uniformity in the product.

"While in a number of cases the difference in uniformity between 'B41' and normal butter is not marked, yet in several instances a sharp distinction is to be noted, as is seen in the scores of Barber and Gurler in the first division of the above table. Not only is the extreme variation in scores less in normal than in 'B41' butter, but what is more important, a larger number of packages of normal butter scored the same, or within one point of each other."

Four experiments were made to ascertain the comparative development of acidity in cream ripened with B41 and without any starter. It has been claimed that the addition of B41 to normal sweet cream delays the rapidity with which the acid is developed, and that consequently the ripening may be continued longer, thus improving the flavor of the butter. In the experiments made on this subject acidity usually developed more rapidly in the cream ripened with B41 than that to which no starter was added, and the B41 cream was invariably the more acid at the conclusion of the experiment.

"The general conclusions from these experiments are summarized as follows:

"(1) Cultures of 'B41' have been examined bacteriologically as they were received from the Culture Co. In every culture examined there has been found associated with the proper organism a small percentage of foreign bacteria and molds.

"(2) The detailed discussion of the flavor scores show, so far as these experiments are concerned, that the Conn culture 'B41' did not improve the flavor of the separator butter ripened for one day at a high temperature, or of that ripened for a longer time at a lower temperature; on the contrary, the score of the fresh 'B41' butter by the different judges was in the majority of cases materially lower than that of normal butter.

"(3) The experiments with gathered cream, as in the separator cream, show that the flavor of the 'B41' butter was poorer than that of normal butter.

"(4) With separator-cream butter in cold storage, that made with 'B41' deteriorated less than did the normal butter. When taken from storage there was but little difference in flavor between these two butters, although the normal butter when fresh scored higher.

"(5) In cold storage the 'B41' butter from gathered cream, on the other hand, did not keep as well as that made from normal cream.

"(6) While the difference in the uniformity between normal and 'B41' butter was not marked, yet the difference, as a rule, was in favor of the greater uniformity of normal butter.

"(7) Four special experiments in ripening cream were made to determine the effect of 'B41' on the development of acidity in cream. The results of these, as well as those of the regular churning experiments, fail to confirm the claim that 'B41' retards the development of acidity in the cream.

"(8) The above conclusions do not agree with the results that have been generally reported where 'B41' has been used in cream ripening. These reported results may possibly be attributed in part to the use of a starter and closer attention to the details of manufacture and not exclusively to the use of the culture organism."

The bacterial flora of Cheddar cheese, H. L. RUSSELL and J. WEINZIRL (*Presented before Sec. G of the American Association for the Advancement of Science, Aug., 1896; abs. in Science, n. ser., 4 (1896), No. 91, p. 430*).—A quantitative and qualitative study was made of the bacteria of American Cheddar cheese. It was observed that there was a diminution in the number of all the species during the first 10 days. There soon begins an enormous development of organisms of the lactic-acid group of bacteria, and the digesting and gas-producing bacteria gradually decrease in number. Succeeding the stage of bacterial increase is a period of decline, until in the course of a year or two the cheese becomes almost sterile. The physical changes that mark the curing of the cheese appear synchronously with the marked development of lactic-acid bacteria. The authors maintain that these facts are at variance with the theory that the digestive bacteria are the active agents in curing.

A bacteriological study of St. Petersburg milk, M. P. SCHARBEKOFF (*Inaug. Diss. St. Petersburg, 1895, pp. 80; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 17, pp. 545–555*).

List of the State dairy commissioners and associations of dairymen in the United States and Canada for 1896 (*U. S. Dept. Agr., Bureau of Animal Industry Circular 10 (Dairy No. 2), pp. 6*).

Dairy bulletin by the dairy school, Guelph (*Ontario Agl. College and Exptl. Farm Bul. 101, pp. 30*).—This is a popular dairy bulletin containing articles by different instructors in the school on the following subjects: Separators and the separation of milk, M. Sprague; care of milk for creameries, J. H. Findlay; care and churning of separator cream, T. C. Rogers; cream-gathering creameries and the private dairy, J. Stonehouse; cheese making, T. B. Miller; a starter, R. W. Stratton; and milk testing, J. W. Mitchell.

STATISTICS.

The number of farm animals in Denmark (*Ugeskr. Landm., 40 (1895), pp. 80–82, 125, 126*).—Statistics giving the number of cattle, sheep, and goats according to the census of 1893 are shown in the article. The number of cattle in 1893 and previous census years was as follows: In 1861, 1,118,774 head; 1881, 1,470,078; 1888, 1,459,527; 1893, 1,696,190; 976,331 of the last number given were in Jutland and 719,859 on the islands. The size of the herds of cattle is shown in the following table, total number of different herds 179,800:

Size of herds of cattle in Denmark, 1893.

Group.		Number of herds.	Total number of cattle.	Per cent of number of herds.	Per cent of number of cows.
1	Large herds (over 50 head)	2,209	221,667	1.2	13.0
2	Medium herds (15 to 49 head)	35,200	793,474	19.6	46.8
3	Smaller herds (4 to 14 head)	72,173	539,301	40.1	31.8
4	Small herds (1 to 3 head)	70,218	141,748	39.1	8.4

During the last 5 years the number of herds in group 1 has been increased by 292, that in group 2 by 7,179, and that in group 3 by 6,416, while the number of herds in group 4 has been decreased by 11,273.

Of the total number of herds of cattle in 1893, 178,070 were made up of milch cows, the total number of milch cows being 1,011,098, or 59.6 per cent of the number of cattle. There were 26,771 service bulls, of which 17,949 were 2 years old or over. Of the former number, 14,281 belonged to the red Danish breed of cattle, and other breeds were represented as follows: Jutland 7,339, Shorthorn 1,228, Holstein 216, Ayrshire 80, other breeds 505, mixed breeds 3,122.

The number of sheep in Denmark has been as follows: In 1861, 1,751,950; 1871, 1,842,481; 1881, 1,548,613; 1888, 1,225,196; 1893, 1,246,-552. In 1893 there were 934,446 sheep in Jutland and 312,106 on the islands. There were 49,213 rams, 40,269 of which were used for breeding purposes. The latter were divided between the following breeds: Native 24,540, Disley and other long-wool breeds 7,858, Southdown and other short-wool breeds 4,608, Merinos and other Spanish breeds 620, and various breeds 2,643.

There were the following number of cattle and sheep per 1,000 inhabitants in 1893: Cattle, in Jutland 1,007 head, on the islands (exclusive of Copenhagen) 767 head; sheep, in Jutland 964, on the islands 331.

The number of goats kept in Denmark in 1893 was 25,266.—F. W. WOLL.

Annual Report of Florida Station, 1895 (*Florida Sta. Rpt. 1895, pp. 8*).—Brief outline by the director of work carried on at station and substations, list of bulletins issued during the year, and a financial report for the fiscal year ending June 30, 1895.

Eighth Annual Report of Illinois Station, 1895 (*Illinois Sta. Rpt. 1895, pp. 16*).—This report includes a general account of the transactions of the governing board, with a tabulated statement showing date of beginning of each experiment in progress and bulletins in which reported, and a detailed financial statement for the fiscal year ending June 30, 1895.

Report of the Iowa Station, 1894 and 1895 (*Sixteenth Bien. Rpt. Iowa State Agl. College and Farm, 1894 and 1895, pp. 23–47, pls. 4*).—This contains reports of the different sections of the station outlining work and bulletins of the period, and financial statements for the fiscal years ending June 30, 1894, and June 30, 1895.

Ninth Annual Report of Nebraska Station, 1895 (*Nebraska Sta. Rpt. 1895, pp. XXXV*).—This includes a brief report by the director on changes in station organization, on progress of work, and on bulletins of the year; outlines of work by the heads of departments; treasurer's report for the fiscal year ending June 30, 1895; and a list of all publications of the station.

Sixth Annual Report of New Mexico Station, 1895 (*New Mexico Sta. Rpt. 1895, pp. 4–40*).—Director's account of improvements and needs of station, publications issued during the year, cost of branch stations, and of a farmers' institute held under station auspices; reports of chiefs of divisions of station and superintendents of branch stations; and treasurer's report for fiscal year.

Sixth Annual Report of North Dakota Station, 1895 (*North Dakota Sta. Rpt. 1895, pp. 14*).—Outline by the director of work in the different departments of the station and a financial statement of the fiscal year ending June 30, 1895.

Eighth Annual Report of Tennessee Station, 1895 (*Tennessee Sta. Rpt. 1895, pp. 16, pl. 1*).—The report contains a financial statement for the fiscal year ending June 30, 1895, and brief outlines by heads of the different departments of the work of the year.

Annual Report of Virginia Station, 1895 (*Virginia Sta. Rpt. 1895, pp. 13*).—Report of director giving list of bulletins issued and in preparation, treasurer's report for the fiscal year ending June 30, 1895, and brief outlines of work by heads of different departments of the station.

Progress of Southern Agriculture, C. W. DABNEY, Jr. (*U. S. Dept. Agr., Office of the Secretary, Circular 3, pp. 12*).—An address before the Farmers' Institute at Ashland, Virginia, June 2, 1896.

The world's trade in eggs, BOYESEN (*Landw. Wochenbl. Schles. Holst., 46* (*1896*), *No. 36, pp. 519–523*).

Grain elevators and associations for selling grain, BACKHAUS (*Hannov. land. und forstw. Ges. Sonderabdruck, 1895, No. 32, pp. 6*).—An address delivered at Göttingen before the central committee of the Royal Agricultural Society of Hanover. It treats of the advantages of grain elevators like those in use in America, and of selling grain, as such sales are conducted in America, through the elevators.

NOTES.

Connecticut Storrs Station.—William J. Karslake, Ph. D., formerly lecturer on chemistry in Dalhousie University, Halifax, has been appointed assistant chemist of the station, to take effect September 15.

Louisiana College and Stations.—T. D. Boyd has been elected president of the college, *vice* J. W. Nicholson, resigned. J. G. Lee, assistant director of the North Louisiana Station, has resigned to become State commissioner of agriculture, and D. C. Sutton has been appointed in his stead. E. B. Fitts, farm manager and tobacconist at the State Station, is succeeded by James Clayton. R. E. Blouin, of the State Station, has been transferred to the Sugar Station at New Orleans, and J. D. Clark has been appointed to succeed him.

Mississippi College and Station.—Dr. Tait Butler has resigned his position as veterinarian, and is succeeded by Dr. J. S. Roberts.

Montana Station.—E. V. Wilcox, Ph. D., has been appointed biologist of the station.

Texas College and Station.—D. Adriance has been compelled by poor health to resign his position as associate chemist in the college and station.

Papers before the Society for the Promotion of Agricultural Science, August 21-22, 1896.—The following papers were read before the Society for the Promotion of Agricultural Science at its seventeenth annual meeting held at Buffalo, New York, August 21 and 22, 1896: "The relation of science to agriculture," by W. R. Lazenby; "On varieties of timothy and red clover" and "Pollen-distributing insects observed on flowers of timothy and red clover," by A. D. Hopkins; "The influence of animal experimentation upon agriculture," by V. A. Moore; "Steer-feeding experiments at the Kansas Experiment Station," by C. C. Georgeson; "A biographical sketch of Dr. C. V. Riley," by L. O. Howard; "White muscardine (*Sporotrichum globuliferum*) of the chinch bug economically considered," by B. M. Duggar; "An antitoxic serum for hog cholera and swine plague. The production of immunity to hog cholera by means of the blood serum of immune animals," by E. A. de Schweinitz; "The relation of the time of seeding and the period of development to the development of rusts and smuts in oats," and "Some further experiments on potato scab," by H. L. Bolley; "Protective inoculation against anthrax," by F. D. Chester; "Forcing cauliflower with lettuce and cucumbers," by H. C. Irish; "New experiments with fungicides for smuts of wheat and oats," by W. A. Kellerman; "A biographical sketch of Prof. C. L. Ingersoll," by C. E. Bessey; "Electro-horticulture: range of incandescent lamps," by F. W. Rane; "Notes on grasses collected between Jefferson, Iowa, and Denver, Colorado," by L. H. Pammel and F. L. Scribner.

Personal Mention.—Dr. A. Zimmermann, of the University of Berlin, has been appointed botanist of the newly founded division of coffee culture in the Royal Botanic Gardens at Buitenzorg.

The new directeur de l'agriculture of France, M. Vastillière, was for a time a farmer in North Carolina, has an American wife, and is fond of this country.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1–11; Vol. VIII, Nos. 1 and 2.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894; No. 20, Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Chicago, Illinois, October, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895; No. 24, Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., November 13–15, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Denver, Colorado, July 16–18, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University, Lafayette, Indiana, in 1895.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use.

Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beatt

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII

No. 4

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
WALTER H. EVANS, PH. D.—Botany and Diseases of Plants.
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C. F. LANGWORTHY, PH. D.—Foods and Animal Production.
F. H. HALL—Statistics and Bibliography.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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STATISTICS.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

VOL. VIII. NO. 4.

The error involved in calculating the protein in feeding stuffs by multiplying the nitrogen content by the factor 6.25 has been much discussed by chemists, and, together with the methods of determining other constituents, has been so severely criticised by them as to cause many laymen to distrust the reliability of fodder analyses in general. The present calculation of protein is, of course, based on the assumption that the proteid bodies in pure state contain, on an average, 16 per cent of nitrogen. This average was fixed upon over forty years ago, when the Weende method for fodder analysis was being elaborated. The nitrogenous constituents of plants have always been among the most difficult substances to study chemically, on account of the difficulty in getting pure preparations of them. At the time the average was adopted it probably represented the best knowledge that was to be had regarding their composition. But as investigation of these bodies has progressed it has become evident that the average was not reliable, in case of certain materials at least, and numerous suggestions have been made for modifying the factor.

As early as 1872 Professor Ritthausen, in his book on The Albuminoid Bodies of Cereals, Legumes, and Oil-bearing Seeds,[1] called attention to the apparent inaccuracy of the factor, as he had found that most proteid bodies which had been examined contained more than 16 per cent of nitrogen, and some as high as 18 per cent. He recommended that 6 be used as the factor in the case of the seeds of cereals, most legumes, and oil-bearing seeds, and 5.5 in the case of lupine seed and certain press cakes.

This suggestion has been adopted by only a few chemists, although the desirability of a change has been frequently discussed. What is perhaps the most forcible argument in favor of a change comes from this same author in an article in a current periodical, abstracted elsewhere (p. 279). Professor Ritthausen has taken pains to compile all the analyses available to him of proteid bodies isolated from various seeds and oil cakes used as feeding stuffs, and presents these in his article.

[1] Die Eiweisskörper der Getreidearten, Hülsenfrüchte und Oelsamen, p. 236.

This shows that considerable progress has been made in studying these substances, and that we have more data than might be supposed on which to base a change of protein factor for certain classes of feeding stuffs. In this country we are indebted to Dr. T. B. Osborne, of the Connecticut State Station, for most valuable contributions along this line, and the importance of his work is thoroughly appreciated abroad. Next to Ritthausen, the compilation shows that his investigations have been more numerous than those of any other chemist.

Out of 98 preparations given in the list only 16 contain less than 16.5 per cent of nitrogen, and 2 of these are not well identified substances. On the other hand, 54 contain over 17.5 per cent of nitrogen and 38 of these contain over 18 per cent. Professor Ritthausen proposes to change the factor for different groups of feeding stuffs in accordance with the data at hand, using 5.7 for the protein of most cereal and leguminous seeds and 5.5 for lupine and oil-bearing seeds. For a few exceptional cases mentioned, 6 is suggested as the most accurate factor. It is shown that, compared with the use of the universal factor 6.25, the above factors give very considerable differences in the protein. With cereals this difference is something like 1 per cent, and with the common oil cakes it is from 3.5 to 5.5 per cent. For instance, the protein of cotton-seed cake calculated by the old factor is 44.05 per cent, and by the new factor (5.5) 38.83 per cent, a difference of 5.22, which is of considerable moment in estimating the feeding value or computing rations of this material.

It is recognized that for many kinds of food and feeding stuffs insufficient work has been done to warrant adopting a new factor, and for such Professor Ritthausen advises continuing the use of the old factor. A continuation of the investigations on different classes of feeding stuffs is of the highest importance to the development of the science of nutrition. Furthermore, the determination of the nonalbuminoid nitrogen should be a more common practice, especially in the case of materials whose composition is not already well known. In ascertaining the right factor for protein these nonalbuminoid materials, which in case of some feeding stuffs constitute a considerable proportion of the total protein, will necessarily have to be taken into account. Their approximate amount has been estimated for a considerable number of feeding stuffs and some work has been done in identifying their constituents. From what we already know it is evident that the variation in the nitrogen content of these constituents is greater even than in case of the albuminoids. For instance, the theoretical nitrogen content of asparagin is about 21 per cent, of betain less than 12 per cent, and of cholin about 11½ per cent. But this work has been fragmentary, and there is abundant opportunity for a systematic investigation of the amount and nature of the nonalbuminoid constituents of various feeding stuffs, not to mention studies of their food value and their function in nutrition.

It is a question whether the analysis of feeding stuffs should not be confined to such materials as have not been frequently analyzed, and to materials which are being grown or used in connection with experiments. This in itself will gradually swell the number and usually give a sufficient basis for averages. Moreover, in view of the present unsettled state of the methods for fodder analysis and the probability that most of the data on this subject will have to be revised in certain respects, it hardly seems worth while to further multiply the analyses of well-known feeding stuffs merely for the purpose of adding to the general fund of information on their composition. There is more important work in contributing data for improving the methods and in studying the nutritive value of the constituents which are being taken account of in modifications of the methods for fodder analysis.

It is gratifying to note that the decision of the recent convention of Official Agricultural Chemists was along this line. Instead of continuing its study of methods based on the present grouping of constituents in fodder analysis, it will direct its attention to methods which supplement these and recognize more definite groups, especially in the nitrogen-free extract. There is already quite general interest in the carbohydrate constituents of feeding stuffs, and a good beginning has been made in studying them. The suggestion of so eminent an authority as Professor Ritthausen in regard to the protein is worthy of serious consideration.

CONVENTION OF ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, 1896.

W. H. BEAL,
Office of Experiment Stations.

The thirteenth annual convention of the Association of Official Agricultural Chemists was held in the lecture room of the National Museum at Washington, D. C., November 6, 7, and 9, B. B. Ross presiding. About 50 members were in attendance.

A committee consisting of W. Frear and J. B. Lindsey was appointed to wait upon the Secretary and Assistant Secretary of Agriculture and invite them to attend the meetings of the Association. The Assistant Secretary responded to this invitation and made a brief address commending the work of the Association.

The president's annual address was devoted principally to a review of recent progress in the methods of analysis of fertilizers, especially those relating to the determination of total and citrate-soluble phosphoric acid. It was pointed out that the official method for the determination of citrate-soluble phosphoric acid is not reliable on all kinds of fertilizing materials. A review of the literature relating to tests of other methods indicate that these methods give equally unsatisfactory results. The advantage to be derived from the publication of official methods in foreign languages as provided for at the International Congress at Paris was briefly discussed. Attention was called to the extensive dissemination of fraudulent formulas for home-mixed fertilizers, and the desirability of the Association giving more attention to the nature and adulteration of human foods was urged. Conservatism in the matter of changing methods was insisted upon.

The usual committee on recommendations of reporters was appointed as follows: H. J. Wheeler, B. W. Kilgore, L. L. Van Slyke, R. H. Gaines, and H. A. Huston.

Fertilizers.—(1) *Phosphoric acid.*—H. B. McDonnell presented a report on phosporic acid, giving a summary of (1) determinations of total phosphoric acid by 15 chemists with the official gravimetric, volumetric, modified volumetric, Gladding, and citrate (Glaser's and modified Glaser's) methods in 3 samples of fertilizers containing from about 11.5 to 28 per cent of phosphoric acid, and (2) determinations of soluble and insoluble phosphoric acid by 10 chemists in 2 of the samples. While the results are not entirely concordant, they indicate that the present official method is reliable. Difficulty from the solubility of the precipitate obtained by the volumetric method as modified by Kilgore was reported.

H. A. Huston presented a paper in which he discussed the effect of time, temperature of digestion, and relative proportions of substance and of solvents upon the citrate solubility of phosphoric acid in slag. The data were given in tabular form and in diagrams. It was shown conclusively that the solution in the citrate is not complete in half an hour, but with the particular sample used required 5 hours for its completion. It was also shown that if sufficient time were given the temperature of digestion had little influence on the amount of phosphoric acid dissolved. In connection with these tests it was incidentally observed that the method prescribed by Wagner for the determination of the basicity of slags is not reliable, as it does not give concordant results. This paper furnished the text for a general discussion of the unreliability of organic solvents in determining the availability of phosphoric acid in different kinds of phosphates. It was clearly brought out that the results obtained by the use of the various citrate methods are wholly misleading in case of certain kinds of phosphates.

A paper on "The amount of washing required to remove the phosphoric acid rendered soluble by digestion with ammonium citrate at 65° C." was presented by F. P. Veitch. Determinations were made of the phosphoric acid in the second, third, fourth, and fifth washings of the residue from digestion with citrate of ammonia in case of 15 fertilizers, with the following average results: In the second washing, 0.129 per cent; in the third, 0.053; in the fourth, 0.043; and in the fifth, 0.027. After washing the residue with 150 cc. of water the next 100 cc. of washings was found to contain 0.051 per cent of phosphoric acid.

A paper by T. S. Gladding, entitled "Discussion on the estimation of phosphoric acid," was read by the secretary. It was shown in this paper that in order to get accurate results in the volumetric method for phosphoric acid it is necessary to add the molybdic solution slowly and to wash only 3 or 4 times with 20 cc. portions of wash water. If the molybdic solution is added all at once the precipitate contains a considerable amount of impurities. If the washing of the precipitate is continued beyond the limits specified the phosphoric acid gradually passes into solution, as was shown by a number of tests of the washings.

The secretary of the Association, H. W. Wiley, submitted a paper on "Mechanical analysis of basic phosphatic slag." The slag was separated into different grades by means of alcohol and the phosphoric acid determined in each grade. A wide difference in phosphoric acid content was shown, and the results suggest the advisability of manufacturers grading their ground slag by some such means before putting it on the market.

It developed in the discussion on methods for phosphoric acid that a number of chemists had found difficulty in getting concordant results with the volumetric method, so it was not deemed advisable to make this method official without further tests. The reporter was therefore

instructed to include in the plan of work for the coming year a test of this method with a variety of phosphatic materials.

Slight changes were made in the method, as follows: In the precipitation of the phosphoric acid by molybdic solution the time of digestion is increased from 6 minutes to 10 to 15 minutes, and in the washing of the precipitate the directions now provide that it shall be washed 5 or 6 times, the total washings amounting to from 150 to 250 cc.

The reporter was also instructed to investigate methods for the determination of iron and alumina in phosphates and of phosphoric acid in slags.

(2) *Nitrogen.*—J. P. Street reported results of comparative tests by 17 chemists of the Ulsch Street, zinc-iron, and "Fassbender" methods, in addition to trials of the modified Kjeldahl and Gunning methods and determinations of ammonia by distillation with magnesium oxid. The results by the Ulsch-Street method in the hands of different chemists were not altogether satisfactory, a number of analysts reporting that for some unexplained cause the method had given wholly unreliable results in some cases, especially on pure nitrates. On the other hand, others reported perfectly satisfactory results in a large number of determinations of nitrogen in a great variety of fertilizing materials. The results as reported by the zinc-iron method were also unsatisfactory. The so-called "Fassbender" method gave good results on the samples used in these tests.

Tests by the New Jersey and Virginia stations of the solubility of organic nitrogen in acid pepsin solution and by the Hayes permanganate method were reported, together with pot tests of the organic nitrogen by the Connecticut State Station. It was decided by the Association that the Ulsch-Street, "Fassbender," and Hayes permanganate methods should be further tested. The reporter was also instructed to inquire into the origin and correct name of the so-called "Fassbender" method.

It was recommended that wherever possible or necessary in reporting the results of analyses of fertilizers the forms of nitrogen should be given; that the ferrous sulphate and sulphuric acid test for nitric nitrogen should be used in case of fertilizers supposed to contain nitrates; that the Schulz-Tiemann and Ulsch-Street methods for nitric nitrogen be compared; and that in determination of ammonia 5 gm. or more of freshly calcined magnesium oxid be used.

A paper on "Comparison of nitrogen determination by the Kjeldahl method distilling with and without potassium sulphid" was presented by W. S. Sweetzer. The results of comparative tests on 53 samples of miscellaneous fertilizing materials indicate that it is unnecessary to add the sulphid, especially when copper flasks are used.

(3) *Potash.*—A. L. Winton reported comparisons by 8 chemists of the Lindo-Gladding and the optional methods for determining potash on chemically pure and commercial muriate of potash and sulphate of

potash, sulphate of potash and magnesia, and kainit (with and without removal of lime). The results are calculated both by the old and new factors.[1] The results were uniformly favorable to the Lindo-Gladding method, which apparently gave results very closely approximating theoretical amounts of potash in the salts used, especially if the Gooch crucible was used. Apparently there was no advantage gained by removal of lime in the case of kainit.

No important changes in the method were adopted. The reporters for the ensuing year, however, were instructed to carefully revise the phraseology of the method, to test the Stassfurt method on pure salts with and without the addition of the impurities ordinarily found in commercial potash salts, and to test the proposed modification of the optional method in which sulphuric acid is precipitated in acid solution. It was decided to omit precipitation of lime in the case of kainit, and it was recommended that in the inspection of fertilizers a test be made for chlorin. In view of recent criticism by Vogel and Haefcke[2] of the Lindo-Gladding method the reporters were instructed to prepare a paper for publication in some leading foreign journal, carefully explaining this method as adopted by the Association.

A paper on "Some sources of error in the determination of potash in fertilizers" was presented by M. A. Scovell, A. M. Peter, and H. C. Curtis. The investigations reported in this paper indicate that in preparing the water solutions of potash in mixed fertilizers containing various porous substances a sufficient amount of the potash is occluded to affect the accuracy of the determination. This is true to a greater extent when there are bulky precipitates of phosphate. It also appears that on evaporating solutions of potash containing soluble phosphates to dryness in porcelain dishes a certain amount of the potash combines with the phosphate to form compounds insoluble in water.

Soils and ash.—A. Goss presented the report on tests of methods of analysis of soils and ash. Four chemists took part in this work, and the results of determinations of phosphoric acid and potash in soils of known history by digestion with $\frac{1}{5}$ normal hydrochloric acid, calcium chlorid, citric acid and oxalic acid; ordinary citrate solution diluted 1 part to 30 of water; and ammonium oxalate (16 gm. per liter) are reported; together with the results of comparative tests of digesting 200 gm. of soil with 1, 2, 3, 4, and 5 liters of $\frac{1}{5}$ normal citric acid. The use of $\frac{1}{5}$ normal hydrochloric acid, calcium chlorid, etc., was referred to the reporter for further study.

The following modification of the method of determining total nitrogen, proposed by the reporter, was adopted: Place 7 to 14 gm. of the soil in an ordinary Kjeldahl flask and boil 1 hour with 30 cc., or as much as is required, of concentrated sulphuric acid and 7 gm. of yellow oxid of mercury. Cool, add permanganate until the color is permanent,

[1] The new factors proposed are for KCl, 0.3069; for K_2SO_4, 0.3587; for K_2O, 0.1939.

[2] Landw. Vers. Stat., 47 (1896), No. 2–3, p. 97.

decant the solution into a 1,000 to 1,200 cc. flask, wash the residue thoroughly by decantation, and proceed as usual. The modified Kjeldahl method is used only when a large amount of nitrates is present.

The reporter was also instructed to test the method proposed by Hilgard for the determination of nitrogen in humus, with a view to its adoption by the Association. He was further instructed to undertake a study of the acidity of soils.

A paper on the action of different soil solvents by H. A. Huston and J. M. Barrett was read by the former.

Feeding stuffs.—J. B. Lindsey submitted a report on coöperative tests, by 6 chemists, of the Sachsse, Maercker, and diastase methods for starch in potatoes and Buffalo gluten feed.

The reporter held that it was useless for the Association to continue studies of the so-called Weende method for the determination of the proximate constituents of foods and feeding stuffs, and that advance in the study of such substances could be made only through efforts to separate the different groups into their individual constituents. He, therefore, selected for the work of the year the above methods for determining starch.

The results of this investigation show that the Sachsse method as a rule gave higher results than the others in case of impure products. It was therefore decided that this method should be adopted as official only for potatoes and commercial starches. The other methods appeared to be about equally convenient and accurate for general purposes.

All of the methods adopted as provisional last year, except that for pentosans, were made official. The following factors for calculating pentosans and their products, based upon the work of Tollens, were substituted for those adopted last year.

Weight of hydrazone $\times$ 0.516 + 0.0104 $\div$ amount of substance taken = furfurol.
Furfurol $\times$ 1.84 = pentosans.
Furfurol $\times$ 1.65 = xylan.
Furfurol $\times$ 2.03 = araban.
Pentosans $\div$ 0.88 = pentoses.

A paper by J. B. Lindsey and E. B. Holland on the "Distribution of galactans in agricultural plants" was read by J. B. Lindsey. It was shown that although galactan is quite generally present in plants, being quite abundant in the leguminous plants, especially the clovers and lupines, it occurs only in very minute quantities in the grains of cereals and some other products.

A paper on "The phloroglucin method for the estimation of pentosans," by J. B. Lindsey and E. B. Holland, was read by the former. This method is described in detail, and comparative tests of it and of the phenyl-hydrazin method on hay, grass, gluten feed, and lupine seeds are reported. The 2 methods gave concordant results, except in the case of English hay and branch grass.

Dairy products.—L. L. Van Slyke submitted a report on work by 3 chemists in testing methods of examining dairy products, particularly the determination of fat in cheese.

The following suggestions of the reporter were adopted by the convention: In sampling, if possible, take a segment of the cheese, cut it into strips, and run through a sausage mill; otherwise take 3 plugs with the sampler, one at the center, one near the outer edge, and one midway between. Use 2 to 5 gm. of cheese in the determination of water and ether extract.

The methods of determining water and ether extract were slightly modified. In the determination of water the use of other absorbent materials besides sand is now permitted. The modifications in the case of the method for determining fat consist principally in more detailed directions and precautions regarding manipulation, so that the extraction may be complete and the extract as free as possible from impurities.

The following method suggested by the reporter for the determination of acid in cheese was made provisional: To 10 gm. of cheese add water at a temperature of 40° C. until the volume is 105 cc. Agitate vigorously, filter, and titrate 25 cc. portion with $\frac{1}{10}$ normal sodium hydrate, using phenolphthalein as an indicator. Calculate as lactic acid.

Methods proposed by the reporter for determining casein and albumen in milk were also made provisional. These methods are substantially the same as already published in bulletins of the Division of Chemistry of this Department.[1] The other methods for cheese adopted as provisional last year were made official.

The reporters were instructed to investigate methods of detecting filled cheese and preservatives in milk.

A paper by J. M. Bartlett on "A modification of the Babcock method and apparatus for testing milk and cream" was read, the modifications proposed consisting principally of (1) filling the bottles with hot water after adding milk and acid before whirling, and (2) graduating the body of the bottles so that no acid measure is needed.

Fermented and distilled liquors.—W. D. Bigelow reported that there had been no coöperative work in this line during the year. On the basis of the studies made by the reporter himself, the following provisional methods were recommended and adopted: A modification of Roese's method for determining fusel oil, the colorimetric determination of aldehyde by means of rosanilin disulphite, and the determination of esters by saponification and titration of the excess of alkali.

Several instruments recently devised for testing liquors for fusel oil were described by Mr. Bigelow. These were Bromwell's modification of Roese's apparatus and Traube's capillarimeter and stalagmometer.

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[1] U. S. Dept. Agr., Division of Chemistry Bulletins 38, p. 109; 43, p. 188 (E. S. R., 6, p. 185).

Sugar.—No report was submitted on this subject.

Tannin.—A report on comparative tests of methods for tannin was submitted by W. H. Krug, in the absence of the reporter, on this subject. A complete revision of the methods for determining tannin was submitted by Mr. Krug and adopted by the Association.

Report of abstract committee.—A brief report on the work of abstracting current literature relating to methods of analysis was submitted by E. W. Allen. The committee numbers 9 persons, and the abstracts are published in the Record. The publication of the work of the present committee began with vol. 7, No. 5, occupying up to the present time about 75 printed pages.

Officers of the Association.—Officers were elected for the coming year as follows: President, W. Frear; vice-president, A. L. Winton; secretary, H. W. Wiley; executive committee, B. W. Kilgore and A. Goss.

As it appeared to be the sense of the Association that reporters should be continued in office for 2 years, the incoming president made few changes in the list of reporters on the different subjects. The reporters therefore remain the same as last year, with the following exceptions: B. D. Westenfelder was made reporter on tannin, and the following associate reporters were appointed: C. H. Jones on potash, W. G. Brown on soils and ash, W. S. Sweetzer on fermented and distilled liquors, and J. H. Yocum on tannin.

The abstract committee is as follows: E. W. Allen, J. T. Anderson, W. D. Bigelow, B. H. Hite, B. W. Kilgore, W. H. Krug, F. W. Morse, H. J. Patterson, and F. W. Woll.

Miscellaneous.—B. W. Kilgore exhibited and described some very delicate instruments devised by Professor Morse, of Johns Hopkins University, for the calibration and graduation of apparatus.

The question of uniformity in units of temperature and volume, etc., was referred to a committee to report at the next convention.

Resolutions of regret on the death of Hon. Edwin Willits, formerly Assistant Secretary of Agriculture, were adopted.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The calculation of the protein from the nitrogen content of the seeds of plants, H. Ritthausen (*Landw. Vers. Stat., 47* (*1896*), *No. 4 and 5, pp. 391–400*).—The author calls attention to the inaccuracy of the factor 6.25 for calculating protein in foods and feeding stuffs. This factor is based on a nitrogen content for the proteid constituents of 16 per cent, which he believes is not in accordance with our present knowledge of the composition of these bodies. In evidence of this he gives a compilation of the elementary analyses of the proteid bodies separated from various cereals, leguminous and oil-bearing seeds, and oil cakes. Omitting some of the oil-bearing seeds of little agricultural importance, the nitrogen content of the proteids is given in the table on the following page.

With reference to this table the author says: "It is apparent that in most cases the proteid bodies of plant seeds contain much more than 16 per cent of nitrogen. Those of the cereals and most legumes grown here average about 17.6 per cent, and of the oil-bearing seeds about 18.2 per cent. This gives the factor 5.7 for calculating the protein of cereals and leguminous seeds, and 5.5 for that of oil-bearing seeds (and cakes) and lupines. The only exceptions to the rule are barley, corn, buckwheat, soja beans, and white beans, the average for which is 16.66 per cent, giving the factor 6; and among the oil-bearing seeds, rape and candle nuts (*Aleurites triloba*), for which 6 is likewise the best factor."

The protein is calculated from the average nitrogen content of the seeds, using the factor 6.25, and in comparison the suggested factors 5.5, 5.7, and 6, respectively. This shows that the factor 6.25 gives a much larger percentage of protein than is believed to be actually present, and in the case of many oil cakes this is 4 or 5 per cent too high.

A number of experiments are given in determining the protein directly, which indicate that there could not be as much present as calculated by the factor 6.25. The adoption of a more correct factor is urged.

Nitrogen content of proteids prepared from various seeds, etc.

	Nitrogen.		Nitrogen.
Wheat:	*Per cent.*	Soja bean—continued.	*Per cent.*
Gliadin (Ritthausen)	18.01	Albumin (Meissl and Böcher)	17.27
Gliadin (Osborne)	17.66	White bean (*Phaseolus*):	
Gluten-casein (Ritthausen)	17.14	Globulin (Ritthausen)	16.32
Glutenin (Osborne)	17.49	Phaseolin (Osborne)	16.48
Gluten-fibrin (Ritthausen)	16.89	Phaselin (Osborne)	14.65
Mucedin (Ritthausen)	16.63	Yellow lupine:	
Globulin (crystallized) (Osborne)	18.39	Conglutin (Ritthausen)	18.67
Proteose (Osborne)	16.80	Legumin (Ritthausen)	17.50
Albumin (coagulated) (Ritthausen)	17.60	Blue lupine:	
Do	17.32	Conglutin (Ritthausen)	18.22
Rye:		Legumin (Ritthausen)	17.52
Mucedin (Ritthausen)	16.84	Rape-seed cake:	
Gluten-casein (Ritthausen)	16.38	Legumin (Ritthausen)	16.60
Gliadin (Osborne)	17.72	Do	17.23
Globulin (Osborne)	18.19	Peanut cake:	
Leucosin (Osborne)	16.66	Globulin (Ritthausen)	18.68
Barley:		Legumin (Ritthausen)	16.98
Gluten-casein (Kreusler)	16.71	Sunflower-seed cake:	
Gluten-fibrin (Kreusler)	15.70	Globulin (Ritthausen)	18.21
Mucedin (Kreusler)	16.98	Globulin and legumin (Ritthausen)	17.99
Albumin (Kreusler)	15.75	Sesame cake:	
Leucosin (albumin) (Osborne)	16.62	Globulin (Ritthausen)	18.38
Globulin (Osborne)	18.10	Legumin (Ritthausen)	16.96
Hordein (fibrin and mucedin) (Osborne)		Cotton seed cake:	
	17.21	Globulin (Ritthausen)	18.31
Oats:		Edestin (globulin) (Osborne)	18.64
Gliadin (Kreusler)	17.71	Hempseed cake:	
Legumin (Kreusler)	17.16	Globulin (crystallized) (Ritthausen)	18.73
Protein, soluble in alcohol (Osborne)	16.43	Globulin (Osborne)	18.68
Globulin (crystallized) (Osborne)	17.86	Globulin and other proteids (Ritthausen)	
Protein, soluble in alkali (Osborne)	16.20		18.06
Corn (maize):		Pumpkin-seed cake:	
Gluten-fibrin (Ritthausen)	16.33	Globulin (Barbieri)	18.08
Globulin (Ritthausen)	17.72	Globulin (crystallized) (Grübler)	18.14
Fibrin (Osborne)	16.13	Globulin (Chittenden)	18.80
Globulin No. 1 (Osborne)	18.02	Globulin (Osborne)	18.51
Globulin No. 2 (Osborne)	15.25	Cocoanut cake:	
Globulin No. 3 (Osborne)	16.82	Globulin (Ritthausen)	17.87
Albumin (Osborne)	15.69	Legumin (Ritthausen)	17.18
Do	17.28	Linseed cake:	
Proteose (Osborne)	15.88	Globulin (crystallized) (Osborne)	18.60
Do	16.59	Proteose (Osborne)	18.78
Buckwheat: Legumin (Ritthausen)	16.48	Albumin (Osborne)	17.44
Peas:		Castor bean:	
Globulin (Ritthausen)	18.26	Globulin (crystallized) (Ritthausen)	18.58
Legumin (Ritthausen)	17.48	Globulin (crystallized) (Osborne)	18.75
Albumin (Ritthausen)	17.14	Globulin (in spheroids) (Osborne)	18.01
Horse bean:		Globulin (amorphous) (Ritthausen)	18.57
Globulin (Ritthausen)	17.78	Albumin (Ritthausen)	16.07
Do	18.15	Brazil nut:	
Legumin (Ritthausen)	17.57	Globulin (crystallized) (Osborne)	18.30
Albumin (Ritthausen)	16.37	Globulin (amorphous) (Weyl)	18.10
Vetch (*Vicia sativa*):		Globulin (amorphous) (Ritthausen)	18.09
Globulin (Ritthausen)	18.43	Globulin (amorphous) (Sachsse)	18.21
Legumin (Ritthausen)	17.64	Potato tubers:	
Flat pea (*Lathyrus*):		Globulin, soluble in water and salt solution (Ritthausen)	
Legumin (Pott)	16.93		15.98
Soja bean:			
Legumin (Meissl and Böcher)	16.38		

Constitution of the cereal celluloses, C. F. CROSS, E. J. BEVAN, and C. SMITH (*Jour. Chem. Soc., 69 (1896), pp. 804–818*).—The following is an outline of the more important results:

"(1) The lignocelluloses of the cereals—for example, the straw and seed envelopes (as obtained in brewers' grains)—are similarly attacked by acid reagents, their furfuroid constituents being hydrolyzed to soluble forms and separated from the complex of cellulose and unsaturated (keto-hexene) molecules.

"(2) These furfuroids have characteristics similar to those isolated from the celluloses; but the hydrolysis of the parent molecule proceeds to a lower limit; the cupric reduction of the soluble furfuroids is relatively low, and the osazones are of lower melting point (120–130°).

"(3) In regard to alcoholic fermentation, however, the furfuroids are obtained in a more sensitive condition. Thus, in the case of barley straw treated with sulphuric acid, the solution, after dilution and filtration from the reprecipitated ligno-cellulose complex, was examined for the above constants, then neutralized and fermented, and the constants of the unfermented residue determined. The following are the results: Percentage reduction referred to dextrose: Before fermentation, 43.5; after fermentation, 2.3. Percentage of furfurol: Before fermentation, 32.3; after fermentation, 8.1.

"The soluble furfuroids were therefore to a very great extent fermented. It appears, also, from the researches of W. E. Stone,[1] that of the total furfuroids in a typical selection of fodder plants, a large proportion, 60 to 80 per cent, are digested on passing through the alimentary tract of Herbivora.

"On the other hand, it is positively established that the pentoses proper are not susceptible of alcoholic fermentation, neither are they assimilated in the process of animal digestion.

"The results, therefore, further indicate that in the cereal stems the furfuroid constituents are not pentosans, but products representing stages intermediate between the hexoses and pentoses."—H. J. PATTERSON.

The pentosans contained in plants, especially feeding stuffs, their determination and properties, B. TOLLENS (*Jour. Landw., 44 (1896), pp. 171–194; abs. in Chem. Centbl., 1896, II, No. 5, p. 304*).—The author emphasizes the necessity of extending the old Weende method for the analysis of feeding stuffs, with respect to crude fiber and nonnitrogenous extract. The crude fiber consists mainly of cellulose, lignin, and wood gum or pentosan. The latter has been frequently found by the author in the crude fiber obtained by the Weende method. It gives a red coloration when moistened with a solution of phloroglucin in moderately concentrated hydrochloric acid. The work of the author and his students in studying the nature and determination of the pentosans is briefly reviewed. The formation of the pentosans can not be explained with any exactness, but it is quite probable that they are formed from cellulose, starch, or other related bodies by oxidation. The greater portion of the pentosans present in the food do not appear in the excrement, and only small portions in the urine, and they are therefore evidently digested. A certain percentage of the pentosans or pentoses (arabinose, xylose) eaten by man appear shortly after in the urine.

More exact knowledge as to the real function of the pentosans in nutrition is much to be desired.—W. H. KRUG.

On the relation between the citrate solubility and soil solubility of phosphoric acid, with special reference to Thomas slag, O. FOERSTER (*Chem. Ztg., 20 (1896), Nos. 40, pp. 391–396; 41, p. 413; 43, p. 422*).—The principles underlying the use of the citrate method are discussed at length and the literature of the subject is reviewed. The varying solvent action on phosphates of acids of the same chemical strength is brought out. It is suggested that the variation in the solubility of the different phosphates is due largely to their state of hydration. The larger the amount of water in chemical combination with the phosphoric acid the more soluble the phosphate.

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[1] Agl. Sci., 7 (1893), No. 1, p. 6.

Experiments have been reported which indicated that hydrated phosphates of aluminum and iron were more effective as fertilizers than tricalcium phosphate. It is claimed that the citrate-solubility is not a true index of the availability of phosphate in the soil, because the same phosphate produces very different effects upon different kinds of soil, as has been frequently shown by field experiments. Among the more important of such experiments those carried out by Gerlach,[1] Ulbricht,[2] and Tacke[3] are noted.

The unreliability of the citrate method as applied to bone meal is shown by citations of the work of Kellner, Kozai, and Mori,[4] C. Antz,[5] and L. Gebek.[6] Gebek's investigations showed that the citrate solubility of bone meal varied directly with the content of gelatin, and this is in conformity with the general opinion that raw bone decomposes in the soil more quickly than steamed bone. It is suggested that these results may be partially explained by the fact that the phosphate of lime is dehydrated and thus rendered more insoluble by the action of the heat in steaming. Other experimenters, including Kellner, have obtained results in field experiments which indicate that the steamed bone is quicker in its action than the raw bone. In conclusion the author claims that the Wagner method is valuable as a comparative test, but that quantitative exactness can not be claimed for it.

Investigations are reported on the citrate solubility of Thomas slag with reference (1) to the relation between the proportions of the solvent and the material to be tested, (2) the time of digestion, (3) the basicity of the material, and (4) the temperature and time of digestion are reviewed at some length, as well as a comparison of the results obtained by this method with those obtained in field experiments, and comparisons of a citrate solution containing 2.4 per cent of citric acid with the ordinary Wagner solution on 7 samples of slag.

A study of the chemical constitution of Thomas slag led to the conclusion that the citrate-solubility of slag is due to the presence of tetracalcium phosphate, and that the presence of a considerable amount of silicic acid is not a sure indication that the phosphate is highly soluble. A slag containing 11.21 per cent of citrate-soluble phosphoric acid was found to contain only 3.88 per cent of silicic acid, while one which showed 4.03 per cent of citrate-soluble phosphoric acid contained 7.24 per cent of silicic acid soluble in ammonium citrate. It is claimed that a slag which is rich in lime may be free from silicic acid and still show a high solubility in citrate. This fact is utilized in the process of E. Bartz,[7] in which phosphorite is mixed with the molten slag, the phosphoric acid of the former being rendered soluble in citrate by the process.

[1] Landw. Vers. Stat., 46 (1895), p. 208 (E. S. R., 7, p. 488).
[2] Landbote, 1889, p. 821; Agr. Chem. Vers. Stat., Dahme, 1894 (E. S. R., 6, p. 626).
[3] Mitt. Ver. Förd. Moorkulturs, 1894, p. 345.
[4] Landw. Vers. Stat., 43 (1894), p. 1-14 (E. S. R., 4, p. 861).
[5] Chem. Ztg., 19 (1895), p. 1875 (E. S. R., 7, p. 293).
[6] Ztschr. angew. Chem., 1894, p. 193 (E. S. R., 7, p. 398).
[7] Chem. Ztg., 1895, p. 1273; see also E. S. R., 7, p. 198.

A method for separating the "insoluble" phosphoric acid in mixed fertilizers derived from bone and other organic matter from that derived from rock phosphates, A. P. BRYANT (*Jour. Amer. Chem. Soc., 18 (1896), No. 6, pp. 491–498*).—The separation depends upon the difference of specific gravity of the materials, and is accomplished by means of a solution of mercuric iodid (100 gm.) in potassium iodid (75 gm.) made up so that the solution has a specific gravity of 2.26.

All water-soluble matter is extracted from 2 gm. of the fertilizer, and the residue is dried before separation. This latter is conducted in 2 tubes 0.3 cm. internal diameter, one of which is 7 cm. long and closed at one end, the other 20 cm. long. These tubes are connected by means of stout rubber tubing, so that the parts may be separated by means of a pinch cock.

The dried residue is placed in one of these combination tubes with 15 to 20 cc. of the above solution, shaken up, and allowed to stand until the separation is complete. Then by closing the cock and removing the lower shorter tube, the lighter and heavier portions of the sample are obtained for separate examination.

Details of manipulation and illustrations of apparatus are given.—H. J. PATTERSON.

On the various modifications of the Pemberton volumetric method of determining phosphoric acid in commercial fertilizers, F. P. VEITCH (*Jour. Amer. Chem. Soc., 18 (1896), No. 4, pp. 389–397*).—The paper gives the results of investigation on (1) the method of filtering and washing; (2) the time of standing after adding the molybdate solution; and (3) the use of tartaric acid to prevent the precipitation of molybdic acid.

The following are the conclusions:

(1) The use of molybdate solution to which nitric acid has been added, allowing the solution and precipitate to stand one-half hour at 40 to 50°, gave results comparing favorably with those by the gravimetric method.

(2) The use of tartaric acid gave good results, but possessed no advantage, and extra time of standing made its use undesirable.

(3) The official molybdate plus 10 cc. nitric acid per 100 cc., using the funnel and paper without pressure in filtering, and only water for washing, was preferred to the usual method.—H. J. PATTERSON.

A modified ammonium molybdate solution, A. L. WINTON (*Jour. Amer. Chem. Soc., 18 (1896), No. 5, pp. 445–446*).—The solution is prepared according to the following formula:

(1) Dissolve 1,000 gm. of molybdic acid in 4,160 cc. of a mixture of 1 part of concentrated ammonia water (specific gravity 0.90) and 2 of water. (2) Dissolve 5,300 gm. of ammonia nitrate in a mixture of 6,250 cc. of concentrated nitric acid (specific gravity 1.4) and 3,090 cc. of water. Add (1) to (2) slowly with constant stirring. Allow to stand and decant off the clear liquid.

The use of this solution makes the usual addition of the 15 gm. of ammonium nitrate to the phosphate solution unnecessary.—H. J. PATTERSON.

The polarimetric determination of lactose in human milk, P. THIBAULT (*Jour. Pharm. et Chim., ser. 6, 4 (1896), pp. 5–10; abs. in Chem. Centbl., 1896, II, No. 6, p. 368*).—The method possesses the advantage of rapidly giving clear filtrates. The clarifying solution consists of 10 gm. pure picric acid and 25 cc. glacial acetic acid in a liter of water. Twenty cc. of milk is shaken with the same volume of the clarifying solution, whereby the albuminoids are coagulated. The clear yellow filtrate is polarized in a 200 mm. tube. The rotatory power is not influenced by the picric acid. The author accepts Tanret's figure 53 for $[\alpha]_D$ of lactose $+1H_2O$. Two divisions on the vernier therefore correspond to 3.88 gm. lactose per liter of milk, which includes the correction for the removed albuminoids.—W. H. KRUG.

The detection of pentoses by precipitation with phloroglucinol and hydrochloric acid, B. TOLLENS (*Ber. deut. chem. Ges., 29 (1896), p. 1202*).—When the pentoses are warmed with phloroglucinol and hydrochloric acid a cherry-red color is produced and the solution gives a characteristic absorption band situated on the more refrangible side of the sodium line. With continued heating the solution becomes dark and a precipitate is finally formed. When this is filtered off and washed it may be dissolved in alcohol, and this solution also exhibits the absorption band quite distinctly. Thus urine containing 1 part arabinose in 1,000 did not show the band, while the alcoholic solution of the precipitate showed it clearly. This appears to be the limit of sensibility of the reaction, and it is less delicate in the presence of other sugars. Pentoses have been detected in various wines by this method. The urine of a sheep fed on peanuts and hay appeared to be free from pentoses.—W. H. KRUG.

Chloraloses, M. HANRIOT (*Compt. Rend., 122 (1896), No. 20, p. 1127; abs. in Jour. Chem. Soc., 1896, Sept., p. 519*).—Galactose readily combines with chloral in the presence of a little hydrochloric acid when heated to 100°, and gives α and β galacto=chloral, $C_8H_{11}Cl_3O_6$. The latter crystallizes from water or methyl alcohol in nacreous lamellæ, which do not sublime readily even in vacuo, are almost insoluble in water and ether, and melt at 202°. It has no action on Fehling's solution. When oxidized with potassium permanganate it gives chloralic acid, $C_7H_7Cl_3O_6$, which is identical with the acid obtained from arabino chloral, and melts at 307°.

Levulose under similar conditions at 80° gives levulochloral, $C_8H_{11}Cl_3O_6$, crystallizing in long needles, very soluble in hot water or alcohol, melting point, 228°.—W. H. KRUG.

The separation of sugars by means of new hydrazones, A. VON ECKENSTEIN and C. A. LOBRY DE BRUYN (*Rec. trav. Chim. Pays-Bas, 15 (1896), p. 97; abs. in Jour. Soc. Chem. Ind., 15 (1896), No. 9, p. 679*).—The sugars can be separated by means of other hydrazins than

that of phenyl, the hydrazones being prepared in the usual manner. Methyl-phenyl hydrazin serves to isolate galactose, and glucose may be separated from fructose by benzyl- and naphthyl-hydrazin. Allyl-phenyl-hydrazin forms a hydrazone with melibiose, which is insoluble in water and is decomposed by benzaldehyde into a crystalline sugar, probably pure melibiose. The hydrazones are characterized by differences in solubility and specific rotatory power.—W. H. KRUG.

The estimation of sugar by the copper method, KALMAN (*Oesterr. Ztschr. Zuckerind. und Landw., 25 (1896), p. 43*).—The cuprous oxid is collected on ignited asbestus in a glass tube and washed with hot water. The asbestus plug is then washed into 50 cc. of a solution consisting of 100 gm. ferric sulphate, 100 cc. concentrated sulphuric acid, and 900 cc. of water. The amount of reduced ferric salt is titrated with twentieth-normal potassium permanganate solution, and the result calculated in terms of copper, as follows: 56 gm. Fe = 63 gm. oxalic acid = 63.3 gm. Cu.—W. H. KRUG.

Dimethylene-gluconic acid, HENNEBERG and TOLLENS (*Liebig's Ann. Phys. und Chem., 292 (1896), No. 1, p. 31*).

Monomethylene-saccharic acid, HENNEBERG and TOLLENS (*Liebig's Ann. Phys, und Chem., 292 (1896), No. 1, p. 40*).

A new pentonic acid and pentose, E. FISCHER and O. BROMBERG (*Ber. deut. chem. Ges., 29 (1896), No. 5, p. 581*).

On the formation of sodium carbonate in nature, S. TANATAR (*Ber. deut. chem. Ges., 29 (1896), No. 7, p. 1034; abs. in Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896). No. 14, p. 1230*).

Gums and resins exuded by Queensland plants, chemically and technologically examined, J. LAUTERER (*Queensland Dept. Agr. Bul. 13, 2d ser., pp. 35–70*).

The decomposition of mono-saccharids by alkalies, F. FRAMM (*Pfluger's Arch. Physiol., 64 (1896), No. 10–12, pp. 575–599*).

The action of alkali on the phenylosazones of di- and polysaccharids, C. J. LINTNER (*Chem. Ztg., 20 (1896), No. 79, p. 763*).—When an aqueous solution of the phenylosazones of di- and polysaccharids is boiled with alkali it becomes turbid and crystals of glyoxalosazone are deposited. Glucosazone is not decomposed.—W. H. KRUG.

The oil of the egg, P. PALADINO and D. TOSO (*Gior. di Pharm. di Chem.; abs. in Jour. Pharm. et Chim., 1896, pp. 247–249; and Analyst, 21 (1896), June, p. 161*).—An examination of the oil from the yolk of the egg, which is used in ointments.

Characteristic reaction of some little-known oils, G. DE NEGRI and G. FABRIS (*Pharm. Post, 1896, No. 17, p. 117; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, pp. 184, 185*).—These include Sabadilla, Kapok, and Batiputa oils, *Oleum Celosiæ, Oleum Lauri indicæ*, Illipe fat, and also cotton-seed oil.

On the relation which exists between the chemical composition of organic compounds and their oxidizability under the influence of laccase, G. BERTRAND (*Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896), No. 12, pp. 791–793*).

Concerning the hydrolosis of melezitose by soluble ferments, E. BOURQUELOT and H. HÉRISSEY (*Jour. Pharm. et Chim., ser. 6, 4 (1896), No. 9, pp. 385–387*).

The behavior of protein compounds toward aldehyde, E. BECKMANN (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), No. 10, pp. 324–329*).—The article is a condensation of two inaugural dissertations. A large number of preparations were investigated to test the method of determining gelatin or albumen in the presence of peptone, by means of "formol" (40 per cent solution of formic aldehyde).

The determination of manganese in the presence of phosphoric acid, G. VIARD (*Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896), No. 15, pp. 973–975*).

A simple method of determining the neutrality of ammonium citrate solution used in the analysis of fertilizers, N. W. LORD (*Jour. Amer. Chem. Soc., 18 (1896), No. 5, pp. 457, 458*).

A new method for the estimation of iron oxid and alumina in phosphate rock, T. S. GLADDING (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 721–724*).—A modification of the ammonium acetate method, which saves time and labor.—H. J. PATTERSON.

Determination of iron oxid and alumina in phosphate rock by the ammonium acetate method, T. S. GLADDING (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 717–721*).—The paper gives many results which prove the accuracy of the method.—H. J. PATTERSON.

Photometric method for the quantitative determination of lime and sulphuric acid, J. I. D. HINDS (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 661–670*).

The determination of uric acid in guano, A. STUTZER and A. KARLOWA (*Chem. Ztg., 20 (1896), No. 75, pp. 721, 722*).

Standard prisms in water analysis and the valuation of color in potable waters, A. R. LEEDS (*Jour. Amer. Chem. Soc., 18 (1896), No. 6, pp. 484–491*).

Determination of organic matter in water by means of chromic acid, J. BARNES (*Jour. Soc. Chem. Ind., 15 (1896), p. 83; abs. in Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896), No. 13, p. 1209*).

Concerning the various methods of estimating cellulose and the pentosans of cotton, H. SURINGAR (*Inaug. Diss. Göttingen, 1896, pp. 57; abs. in Bot. Centbl., 68 (1896), No. 3, pp. 44, 45*).

On the action of Wagner's reagent upon caffein and a new method for the estimation of caffein, M. GOMBERG (*Jour. Amer. Chem. Soc., 18 (1896), No. 4, pp. 331–342*).

The action of chloroform on starch, F. MUSSET (*Pharm. Centralhalle, 37, p. 587; abs. in Chem. Centbl., 1896, II, No. 14, p. 703*).

Concerning the formation of galactose, A. BAU (*Neue Ztschr. Rübenz. Ind., 37 (1896), No. 13, pp. 159–166*).

Distinction between beet and cane sugar (*Sugar Cane, 28 (1896), No. 328, pp. 580–582*).—Prof. F. G. Wiechmann states in a letter which is quoted that there is no fixed relation between the amounts of soda in the ashes of beet and cane sugars. "As a rule, the ash of beet sugars contains but a small amount of calcium and magnesium as compared with the quantity of potassium and sodium. In cane-sugar ash the amount of the alkaline earths compared with the alkalies present is greater."

A simple and convenient extraction apparatus for food-stuff analysis, J. L. BEESON (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 744, 745, fig. 1*).

The presence of amins in sugar-cane juice, J. L. BEESON (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 743, 744*).

A chemical-physiological examination of the sugar cane, WENT (*Deut. Zuckerind., 21 (1896), p. 1760; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 244*).

Products of condensation of phloroglucin with sugars, etc., C. COUNCLER (*Chem. Ztg., 20 (1896), No. 59, p. 585*).

The inversion of sugar by salts, II, J. H. LONG (*Jour. Amer. Chem. Soc., 18 (1896), No. 8, pp. 693–717*).

The gravimetric estimation of sugars with Fehling's solution, H. ELION (*Rec. trav. Chim. Pays-Bas, 15 (1896), p. 116; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 243*).

Annual report of the official analyst of the Island of Jersey, F. W. TOMS (*Rap. ann. L'analyste Officiel l'année terminant le 25 Mars, 1896, pp. 13*).—A brief report of the work of the year, including analyses of alcoholic liquors, waters, milk, butters, petroleum, etc.

The development of the periodic law, F. P. VENABLE (*Easton, Pa.: Chemical Pub. Co., 1896, pp. 321, pls. 18*).

The hygienic laboratory, H. B. KENWOOD (Methods of bacterial research by R. Boyce) (*Philadelphia: P. Blakiston, Son & Co., 1893, pp. 17, 491, figs. 116*).—A laboratory manual of the analysis of water, soil, air, gas, food, etc.

Chemical experiments, general and analytical, R. P. WILLIAMS (*Boston and London: Ginn & Co., 1895, pp. XV, 111, figs. 40*).—Detailed directions are given for performing experiments with 102 different elements—salts, acids, etc. The book contains much information of a general nature relating to the performance of chemical experiments.

Notes on qualitative analysis, W. P. MASON (*Easton, Pa.: Chemical Pub. Co., 1896, pp. 56*).—A laboratory manual.

Chemistry for beginners, E. HART (*Easton, Pa.: Chemical Pub. Co., 1896, pp. 245, figs. 62, pls. 2, 3d ed., revised and enlarged*).

BOTANY.

Assimilatory inhibition in plants, A. J. EWART (*Jour. Linn. Soc. Bot., 31 (1896), No. 217, pp. 364–461*).—The author has given the results of a prolonged series of experiments carried on under the direction of Pfeffer, of Leipsic. The method adopted for determining oxygen evolution was by the use of the *Bacterium termo* of Cohn. The cultures used were always under 2 weeks old in order to secure actively motile forms. The agents studied were heat—dry and moist—cold, irrespirable gases, ether, acids, alkalies, antipyrin, accumulation of assimilatory products, and insolation. The age of the leaf cell or chlorophyll grain at which assimilation begins was also studied. The experimental material covers quite a range of plants representing phanerogams, mosses, lichens, etc.

The author's conclusions are as follows:

"By the operation of a variety of agencies a condition of assimilatory arrest or inhibition may be induced in living chlorophyllaceous cells and tissues. These are: dry heat, moist heat, cold, desiccation, partial asphyxiation, etherization, treatment with acids, alkalies, and antipyrin, accumulation of the carbohydrate products of assimilation, immersal in very strong plasmolytic solutions, and prolonged insolation.

"The inability to assimilate is, if the cell remain living, only temporary, being followed sooner or later by a more or less complete recovery of the power of assimilation.

"During the whole time in which the power of assimilation is absent the cell continues to respire. By the direct effect of each particular agency, the respiratory activity may in some cases be but little affected (etherization, overaccumulation of carbohydrates), in one case is increased (moist heat), but in most is diminished (cold, desiccation, immersion in strong plasmolytic solutions). The question, whether or not an after effect may also be produced on respiration, does not sensibly affect the results obtained as regards assimilation. If the inhibition of assimilation experimentally produced be permanent the cell finally dies and ceases to respire.

"In the great majority of cases no visible change in the chlorophyll or the chlorophyll grain is associated with the stoppage of assimilation. In such cases assimilatory arrest probably originates in the plasmatic stroma of the chlorophyll corpuscle, and may be due to some breakage in the necessary vital connection between the assimilatory pigment and the assimilatory plasma.

"Most of the above inhibitory agencies operate by checking or arresting the initial stages or primary processes of assimilation (decomposition of CO_2 and formation of carbohydrate); but since the accumulation of carbohydrate affects assimilation, any cause interfering with the rapidity of its removal from the assimilatory cells may also finally affect their power of assimilation.

"Hence in the plant, as a whole, assimilation may be influenced by the causes operating upon the general cell protoplasm and affecting the latter stages in the process of assimilation (absorption, elaboration, and transformation of the assimilated carbohydrates), either of the assimilatory cell itself or of the cells which are dependent upon it for their supply of carbohydrate food material, or by a closure of the channels through which these carbohydrates are removed.

"Cells in which the green color of the chlorophyll grains is quite masked by the presence of a brown or reddish-brown pigment may show a distinct power of assimilation. If the reduction of the chlorophyll be complete assimilation ceases.

"In certain cases isolated chlorophyll bodies may continue to assimilate for a short time after removal from the cell to which they belong.

"A developing leaf in which the chlorophyll grains are being formed '*ab initio*' by protoplasmic differentiation lacks at first the power of assimilation. The commencement of assimilation is determined mainly by the development of the chlorophyll pigment, but is also largely influenced by other indeterminate factors, probably plasmatic in origin."

Variation of seed as influenced by climate and soil, E. GAIN (*Rev. gén. Bot.*, *8* (*1896*), *No. 91*, *pp. 303–305*).—The author gives a résumé of his own work,[1] and that of J. Raulin[2] and A. Müntz[3] relating to this subject. The influence of moisture and drought have already been considered in these pages at considerable length (E. S. R., 8, p. 3). The investigations of Raulin with wheat were conducted in two unlike situations, Lyons and Ardennes, and the effect of changes in soil and climate noted. The seed harvested at each station was divided and portions from each place planted the succeeding year. In general, the average weight of 100 grains of wheat grown at Lyons was less than that grown at the other station. Three factors were found to influence variation: (1) weight of seed, (2) local conditions, and (3) the ancestry of the seed. One of the factors easily recognized is change of soil for each generation, it being shown that a change in the chemical nature of soil is favorable to increased production, and that there is a maximum and a minimum influence dependent upon the succession of the various soils. For example, the maximum for wheat is as follows: Seed sown upon humus soil should have been grown on clay soil for the best results; those sown on sandy soil should have been grown on calcareous soil; for clay and calcareous soils, the seed should have been grown on sandy soils. Minimum results follow sowing wheat on humus soil that has been previously grown on humus or calcareous soils, on sandy soil where grown on humus or sandy soils, on clay when coming from humus or clay soils, and on calcareous soils when previously grown upon humus or calcareous soils. The principles here enunciated are thought to probably apply to all kinds of plants, and this variation is believed

[1] Ann. sci. nat. Bot., ser. 7, 20 (1895), p. 63 (E. S. R., 7, p. 366).
[2] Ann. Sci. Agron. ser. 2, 1 (1896), No. 2, p. 311.
[3] Ibid., p. 161.

to offer a field for practical experimentation. It may further be seen that the most fertile soil does not always produce the most prolific seed, since in the examples cited the maximum result was not attained where seed was grown continuously upon the same soil nor upon humus soils of great fertility. From this it appears that what may be best for the individual may not prove the optimum for the race.

It is urged that in the selection of seed the chemical nature of the soil where it is grown should be considered as an important factor. Continually growing seed upon the same soil under identical conditions is liable to produce a degenerate race, and to this factor is due the necessity of a renewal of seed from time to time. This also will account for the otherwise unexplained disappearance of rare plants from their known habitats.

In general, seed grown in a more northern latitude when transferred to a given region will produce varieties more adapted to maintain themselves and produce larger yields than those grown in that region.

Continued reproduction *in situ* is unfavorable both as regards the yield and stability of the race or types, since the number and average weight of seed tends to diminish. "Natural phenomena, even those apparently of slight consequence, may, through their continued and general application, produce a considerable effect upon plants and animals."

Concerning a new system of plant classification, F. DELPINO (*Mem. Reale Accad. Sci. Bologna, ser. 5, 6 (1896), pp. 86–116; abs. in Bot. Centbl., 67 (1896), No. 12, pp. 370–374*).

Comparative anatomy of some species of Carex and their hybrids, G. MARGGRAFF (*Leipzig, 1896, pp. 69, pls. 4; abs. in Bot. Centbl., 68 (1896), No. 2, pp. 50–52*).

A new species of grass in Great Britain, G. C. DRUCE (*Jour. Linn. Soc. Bot., 32 (1896), pp. 426–430*).—*Bromus interruptus*, n. sp., is described.

Roseanthus, a new genus of Cucurbitaceæ, A. COGNIAUX (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 9, pp. 577, 578, pl. 1*).—*Roseanthus albiflorus* is described and figured as new. The plant came from Acapulco, Mexico.

A revision of the genus Silene, F. N. WILLIAMS (*Jour. Linn. Soc. Bot., 32 (1896), pp. 1–196*).

Crepis occidentalis and its allies, F. V. COVILLE (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 9, pp. 559–565, pls. 6*).—A critical study is made of this polymorphous species and some of the forms are separated as new species.

Liebergia, a new genus of Umbelliferæ, J. M. COULTER and J. N. ROSE (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 9, pp. 575, 576, pl. 1*).—A new umbellifer from the Columbia River region is figured and described.

Notes on Uromyces amygdali, a synonym of Puccinia pruni, D. MCALPINE (*Proc. Linn. Soc. New South Wales, 10 (1896), No. 3, pp. 440–460, pls. 3*).

New species of fungi, C. H. PECK (*Torrey Bul., 23 (1896), No. 10, pp. 411–420*).—Twenty-five new species are described, most of which are from the United States.

Redescriptions of Berkeley's types of fungi, G. MASSEE (*Jour. Linn. Soc. Bot., 31 (1896), No. 218, pp. 462–525, pls. 3*).

Biological studies of Saccharomycetes and Oïdium spp., C. FERMI and E. POMPONI (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 574–578*).

The morphology and development of certain pyrenomycetous fungi, MARY A. NICHOLS (*Bot. Gaz., 22 (1896), No. 4, pp. 301–338, pls. 3*).

Investigations of the physiological anatomy of fungi, with special reference to the conductive systems of Hydnei, Telephorei, and Tomentellei, G. VON ISTVANFFI (*Pringsheim's Jahrb. wiss. Bot., 29 (1896), No. 3, pp. 391–440, pls. 5*).

Organs of attachment in Botrytis vulgaris, MARGARETHA E. C. HORN (*Bot. Gaz., 22 (1896), No. 4, pp. 329–333, pl. 1*).

Concerning the physiology and biology of evergreen plants, a preliminary paper, B. LIDFORSS (*Bot. Centbl., 68 (1896), No. 2, pp. 33–44*).

A contribution to the structure and function of stomata, H. C. SCHELLENBERG (*Bot. Ztg., 54 (1896), No. 10, pp. 169–185, pl. 1*).

Osmotic pressure, W. C. D. WHETHAM (*Nature, 54 (1896), No. 1407, pp. 571, 572*).

Concerning root secretions, F. CZAPEK (*Pringsheim's Jahrb. wiss. Bot., 29 (1896), No. 3, pp. 321–390*).

Etiolation as a phenomenon of adaptation in plants, F. DARWIN (*Jour. Roy. Hort. Soc., 19 (1896), pt. III; abs. in Bot. Ztg., 54 (1896), II, No. 19, pp. 297, 298*).

The mechanism of movement and transmission of impulses in Mimosa and other sensitive plants, D. T. MACDOUGAL (*Bot. Gaz., 22 (1896), No. 4, pp. 293–300, pl. 1*).—A review, with account of some recent experiments.

Sensibility in plants, F. NOLL (*Ber. Senchenbergische natur. Ges., 1896, pp. 169–257*).

On the decomposition of albuminoid substances during germination, D. MOROSOV (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 425–427*).

Formation of carbon bisulphid by Schizophyllum lobatum, F. A. F. C. WENT (*Ber. deut. bot. Ges., 14 (1896), pp. 158–163; abs. in Jour. Roy. Micros. Soc., 1896, No. 114, p. 548*).—The author claims to have established by chemical means the fact that this fungus growing upon dead bamboos and sugar canes is able to produce carbon bisulphid.

On the simultaneous occurrence of laccase and tyrosinase in the juice of certain fungi, G. BERTRAND (*Compt. Rend., 123 (1896), No. 11, pp. 463–465*).

Localization of the alkaloids of Solanaceæ, P. MOLLE (*Mem. Acad. Roy. Belgique, 1895; abs. in Bot. Centbl., 67 (1896), No. 12, pp. 368, 369*).

The tannin of some acorns, H. TRIMBLE (*Amer. Jour. Pharm., 68 (1896), No. 11, pp. 601–604, figs. 2*).—Notes are given of the tannin content of the acorns of 7 species of oaks.

Bud variation in the Concord grape, W. PADDOCK (*Garden and Forest, 9 (1896), No. 456, pp. 464–466*).

On modification and variation, C. L. MORGAN (*Science, n. ser., 4 (1896), No. 99, pp. 733–740*).

A microscopical study of germinated barley grains, J. GRÜSS (*Wochenschr. Brauerei, 1896, No. 28, p. 730; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 585–588*).

On the effect of water currents on the assimilation of aquatic plants, F. DARWIN and PERTZ (*Proc. Cambridge Phil. Soc., 9 (1896), II; abs. in Bot. Ztg., 54 (1896), II, No. 19, p. 296*).

The temperature limits of mold fungi in various nutrient media, R. THIELE (*Inaug. Diss. Leipzig, 1896, pp. 37; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 583–585*).

Chemical and experimental investigations on the poisonous properties of juniper berries, L. T. DELVAL (*Lille: Danel, 1896, pp. 75*).—A thesis.

On the ability of bacteria to adapt themselves to different genera of Leguminosæ (*Deut. landw. Presse, 23 (1896), No. 77, pp. 685, 686, figs. 3*).

Röntgen rays applied to the study of flower buds and seed vessels, G. J. BURCH (*Gard. Chron., ser. 3, 20 (1896), No. 513, p. 491, figs. 2*).

Experiments on the influence of the variation of climate on vegetation, J. RAULIN (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 2, pp. 311–320*).

Distribution of plants on the south side of the Alps, J. BALL (*Trans. Linn. Soc. Bot., ser. 2, 5 (1896), No. 4, pp. 119–227*).

Contributions to the arboreal flora of Java, III, S. H. KOORDERS and T. VALETON (*Medel. 'sLands Plantentuin, No. 16, pp. 320*).—Technical and economic notes, together with descriptions of new species of trees of Java are given.

Some New South Wales plants worth cultivating for shade, ornament, etc., J. H. MAIDEN (*Dept. Agr. N. S. Wales, 1896, June, pp. 39*).—Economic notes are given of numerous species of plants in New South Wales.

Contributions to Queensland flora, F. M. BAILEY (*Queensland Dept. Agr. Bot. Bul. 13, pp. 34, pls. 4*).—Descriptive notes are given of some additions to the flora of Queensland.

The grasses of Uruguay (continued), J. AVECHAVALETA (*Anal. mus. nacional Montevideo, 1896, No. 5, pp. 373–452, pls. 14*).—Descriptions and illustrations are given of some of the grasses of the region designated.

Geographical distribution of medicinal plants, G. PLANCHON (*Jour. Pharm. et Chim., ser. 6, 4 (1896), No. 9, pp. 389–397*).—This paper gives the distribution of the principal medicinal plants of the United States.

The myxomycetes of the Miami Valley, Ohio, A. P. MORGAN (*Jour. Cincinnati Soc. Nat. Hist., 19 (1896), No. 1, pp. 44, pls. 3*).

Flora of southwestern Kansas, A. S. HITCHCOCK (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 9, pp. 537–557*).—A report on a collection of plants made by C. H. Thompson in 1893.

Flora of the Black Hills of South Dakota, P. A. RYDBERG (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 8, pp. 463–540, pls. 4*).—A critical report is made on the flora of the Black Hills region as observed by the author on a collecting trip made through that region in 1892. The distribution of the plants as affected by the geological, topographical, and meteorological conditions is discussed and a catalogue given of the plants collected. Several new species and varieties are described.

First report on the flora of Wyoming, A. NELSON (*Wyoming Sta. Bul. 28, pp. 47–218, figs. 3, map 1*).—A preliminary report is given of the flora of Wyoming, based upon extensive collections made during the seasons of 1894 and 1895, represented by about 1,600 numbers. A descriptive report is given of the itinerary of the expeditions, together with critical notes on the different local floras, and a list of species with critical notes. Sixteen new species and varieties are described.

Plants from the Big Horn Mountains of Wyoming, J. N. ROSE (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 3, No. 9, pp. 567–574*).—A report is given of a collection of plants made in 1893.

An illustrated flora of the Northern United States and Canada, etc., I, N. L. BRITTON and A. BROWN (*New York: Chas. Scribner's Sons, 1896, pp. XII, 612, figs. 1,425.*)—An illustrated manual of northeastern United States arranged in the main according to the system of Engler and Prantl and the nomenclature of the Rochester rules.

Vegetable physiology with special reference to agricultural plants, A. B. FRANK (*Lehrbuch der Pflanzenphysiologie mit besonderer Berücksichtigung der landwirthschaftlichen Culturpflanzen. Berlin: P. Parey, 1896, 2d ed., pp. VII, 205, figs. 57*).

A manual of botany, Vol. II, J. R. GREEN (*London: J. and A. Churchill, 1896; reviewed in Nature, 54 (1896), No. 1407, pp. 570, 571*).—This volume is devoted to classification and physiology.

METEOROLOGY.

The rainfall of Nebraska, G. D. SWEZEY and G. A. LOVELAND (*Nebraska Sta. Bul. 45, pp. 129–177, charts 37*).—A complete record of observations on rainfall in Nebraska from 1876 to 1895 is given in tables and charts. In preparing the charts of normal rainfall "only those stations were used which had a complete record for this period, or, if certain months or years were wanting from the record, the amount of rainfall for these missing periods was taken by estimation from the monthly or annual charts of precipitation for these months or years. Since these charts were compiled from the data furnished by all the stations in the vicinity of the stations in question, they furnish a valuable clew to the probable rainfall of a given locality."

"The precipitation in Nebraska occurs mainly in connection with the passage of areas of low barometer across the country. The prevailing direction of our rain-bearing winds is from the southeast, and, by tracing these winds back to their source, it is found that in a large percentage of cases they come from the region of the Gulf of Mexico. . . .

"These southerly moisture-laden winds, flowing northward in advance of a low barometer area and cooling as they go, precipitate more or less of their moisture on the eastern or southeastern side of the low area; much of the rainfall in the summer occurs in connection with thunder storms which form as a rule in the southeastern quadrant of the area of low barometer. After the low area has passed and the winds have changed to northerly directions behind it, still further precipitation often occurs from the cooling of the moist atmosphere by the admixture of the cold air imported from the north with the warm, moist air originally derived from the southeast.

"Much of the winter precipitation falls as rain rather than as snow. Heavy falls of snow occasionally occur, but much of the time during the winter the ground is bare in the southern half of the State.

"The total amount of precipitation for the year in Nebraska and adjacent regions ranges from about 13 in. at the extreme southwestern corner of the State to about 34 in. at the extreme southeastern. . . . The average annual rainfall for the State as a whole is 23.33 in. . . . [Of this] 16.08 in., or 69 per cent of the entire amount, falls during the 5 months of the growing season, April to August inclusive. . . .

"[Nebraska therefore has] the advantage over the States lying farther to the east that a large percentage of its rainfall occurs in the growing season, when it is most useful. . . .

"At the western end of the State the largest monthly rainfall occurs in May; farther east the rainfalls of May, June, and July are not greatly different; while at the extreme eastern end of the State the period of greatest rainfall is delayed until June.

"[From the observations recorded] it appears that there is rain in Nebraska at any one locality on the average 1 day in 4, and that when it rains there falls on the average about a quarter of an inch a day; . . . that there are but 6½ days in the year in which as much as an inch falls in a day, although the total amount falling in these quantities is of course considerable; . . . that but a trifling amount of the total yearly precipitation falls in showers of less than one-tenth of an inch per day; . . . and that the greatest uncertainty as to the amount of precipitation occurs in those months of the year when but little falls in any case. During the 5 months of the growing season, April to August, inclusive, the liability to a deficiency does not vary greatly, although the greatest uncertainty occurs unfortunately in the month of July, when a deficiency is liable to affect the corn crop so seriously. . . .

"If we examine the precipitation for the series of years from 1849 to 1895, inclusive, we shall find that, although the rainfall of the past few years has been less than that

of the earlier years of the series, so far as we can judge from the rather meager records of those earlier years, yet there is afforded no evidence of any considerable progressive change in the climate of the State, toward either wetter or drier conditions."

Meteorological summary for Ohio, 1895, C. A. PATTON (*Ohio Sta. Bul. 66, pp. 161–171*).—Notes on the weather, and tabulated daily and monthly summaries of observations at the station on temperature, precipitation, cloudiness, direction of the wind, etc., are given; and for comparison similar data for previous years and for other parts of the State are added. The following is a summary of results:

Summary of meteorological observations.

	For the experiment station.		For the State.	
	1895.	For 8 years.	1895.	For 13 years.
Temperature (° F.):				
Mean	47.8	49.2	49.9	50.50.
Highest	98 (June 4)	99 (Aug. 8, 1891)	106 (July 20)	108 (July 18, 1887).
Lowest	−6 (Jan. 12, 13, Feb. 5).	−20 (Jan. 20, 1892)	−24 (Feb. 6)	−34 (Jan. 25, 1884).
Range	104	119	130	142.
Mean daily range	21.8	20.4	23.4	20.5.
Greatest daily range.	55 (Oct. 6)	55 (Oct. 6, 1895)	59 (Jan. 15, Mar. 29).	60 (Oct. 19, 1894).
Least daily range	1 (Nov. 27)	1 (Nov. 27, 1895)	0 (Feb. 7)	0 (Feb. 7, 1895).
Clear days	125	116	143	117.1.
Fair days	117	127	119	123.1.
Cloudy days	123	116	103	125.9.
Days rain fell	102	124	89	124.7.
Rainfall (inches):				
Total	31.45	39.02	28.46	37.74.
Greatest monthly	4.21 (Nov.)	7.89 (June, 1892)		
Least monthly	1 (Feb.)	37 (Oct., 1892)		
Mean daily			0.07	0.102.
Direction of wind	N	S	SW	SW.

The tornado at Paris, September 10, 1896, A. ANGOT and J. JAUBERT (*Compt. Rend., 123 (1896), No. 11, pp. 460–463*).

Meteorological observations during August and September, 1896, L. METCALF and J. L. BARTLETT (*Massachusetts Hatch Sta. Met. Buls. 92, pp. 4; 93, pp. 4*).—The usual notes on the weather and summaries of observations.

Meteorological observations, July and August, 1896, H. B. BATTLE and C. F. VON HERRMANN (*North Carolina Sta. Met. Buls. 82, pp. 109–124, maps 2; 83, pp. 127–142, maps 2*).—The usual summaries of observations by the North Carolina section of the climate and crop service of the U. S. Weather Bureau coöperating with the North Carolina Station.

Meteorology (*South Dakota Sta. Rpt. 1894, pp. 8, 9*).—A tabulated monthly summary of observations on temperature, atmospheric pressure, and rainfall for the period from May 17, 1888, to December 31, 1894, and a daily summary of observations on humidity for the 6 months ending September 30, 1890.

Notes on climate, J. D. CONLEY (*Wyoming Sta. Rpt. 1895, Appen., pp. 85–96*).—A reprint of Bulletin 23 of the station (E. S. R., 7, p. 286).

WATER—SOILS.

The number of inches of water required for a ton of dry matter in Wisconsin, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 240–248*).—Experiments similar to those already reported (E. S. R., 7, p. 567) were

made with potatoes and oats. The potatoes were grown in 8 galvanized iron cylinders 18 in. in diameter and 42 in. deep, 2 of which were sunk flush with the ground in the open field and the others stood above ground where they could be sheltered. The experiments differed from previous ones in the method of applying water and in not allowing any rain to fall upon the pots.

"The method of watering adopted was to set up within each cylinder a column of 3-inch drain tile close against one side and to add water by pouring it into this tube from time to time as needed, taking care always to add no larger quantity at a time than would raise the water in the tile 6 in. above the bottom. All the water these potatoes received was therefore procured through capillarity and root action from a depth equal to or exceeding 3 ft."

The results obtained in these experiments were as follows:

Amounts of water used by the potato.

	Dry matter per cylinder.	Water used per pound of dry matter.	Dry matter per acre.	Total water used.	Acre-inches of water per ton of dry matter.
	Pound.	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*
No. 1	0.5130	430.4	12,650	24.02	3.80
No. 2	.5258	415.0	12,960	23.74	3.66
No. 1	.3338	586.9	8,248	21.31	5.17
No. 2	.5007	480.9	12,340	26.20	4.25
No. 3	.4505	516.8	11,110	25.33	4.56
No. 4	.5020	472.1	12,370	25.78	4.17
No. 5	.3596	497.3	8,865	23.37	5.27
No. 6	.5425	458.4	13,370	27.06	4.05

The potatoes were injured by blight, and for this reason the production of dry matter was not as high as it otherwise would have been, but—

"It is evident enough from the table, whatever may be said regarding the yields of dry matter, that the potatoes did use a very large amount of water, in fact a quantity 3 times the amount of the rain which fell during their period of growth, and since the surface of the ground was kept dry through the whole season very much the larger proportion of the water must have passed through the vines and only a small part could have been lost through the soil directly."

Experiments of this kind have been made on oats grown in cylinders sunk in the ground during 3 years with the following results:

Amount of water used by oats.

	Water used per cylinder.	Dry matter per cylinder.	Water used per pound of dry matter.	Dry matter per acre.	Total water used.	Acre-inches of water per ton of dry matter.
1891.	*Pounds.*	*Pound.*	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*
No. 1	224.25	0.4405	509.3			
No. 2	220.70	.4471	493.6	8,861	19.69	4,444
1892.						
No. 1	174.60	.3322	525.6	8,189	19.00	4,640
1894.						
No. 1	282.80	.5232	540.6	12,900	30.77	4,770
No. 2	280.20	.5163	542.7	12,730	30.48	4,789
No. 1	283.30	.4198	674.9	10,350	30.82	5,956
No. 2	286.60	.4663	614.7	11,500	31.18	5,424

"It will be seen from this table that while the total yield of dry matter was much larger in 1894 than in the other 2 years, the amount of water used was also relatively higher, the 3 trials of 1891 and 1892 averaging 509.5 lbs. of water for 1 lb. of dry matter, while the average for the 4 cases in 1894 is 593.2 lbs. of water to 1 of dry matter; the general average of the 7 trials being 557.3 lbs. to 1."

The results of all experiments of this character made at the Wisconsin Station are summarized as follows:

Amount of water required for a pound of dry matter in different crops.

	No. of trials.	Water used per pound of dry matter.	Dry matter per acre.	Acre-inches of water per ton of dry matter.
		Pounds.	*Pounds.*	*Inches.*
Dent corn	4	309.84	19,515	2.64
Flint corn	4	233.90	25,099	2.14
Red clover	3	452.80	9,613	4.03
Barley	3	392.89	10.819	3.43
Oats	5	557.34	10,755	5.02
Field peas	1	477.37	8,017	4.21
Potatoes	2	422.70	12.805	3.73

"It must be understood in considering these results that they apply to trials made under conditions where none of the water used could be lost by percolation, and that in irrigating very open soils, more water would be required unless applied in small quantities at a time."

Field experiments on the percolation of water as related to irrigation, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 249–265, fig. 1*).—Observations were made on this point on tile drains covering an area of about 5 acres, and measuring 7,022 ft. in length.

"These tile are laid at a mean depth of about 4 ft. in a soil which consists of 6 to 8 in. of a medium clay loam at the surface, followed by 2.5 to 3 ft. of clay, and below this a rather coarse sand in the upper portion of which the tile are laid. In [a portion of the system] the lines of tile are 33 ft. apart, but the laterals leading into the main extending from [the silt well] to the lake have a greater distance."

Water was forced up into this system of tiles through the outlet drain of the system by means of a rotary pump, having a capacity of 100 gals. per minute.

In the first experiment water was pumped 33 hours during portions of 4 consecutive days.

"Systems of 4-inch auger holes were put down at varying distances from the lines of tile and in different portions of the area under experiment in which the height of the ground water could be determined by direct measurement. A second method consisted in taking samples of soil in 1-foot sections to a depth of 4 ft. along lines parallel with but at different distances from the drains and then determining the amount of water these samples contained when taken before and after the close of the experiment."

It was found that it was possible with this small pump to force water into the system of drains as fast as it would percolate.

"Through the sampling of the soil it was learned that during the 8 days following this first experiment, the outlet of the drain having been kept closed, the water content of the soil changed as indicated in the table below."

Changes in the water content of soil irrigated through tile drains.

	Surface foot lost.	Second foot gained (+) or lost (—).	Third foot gained.	Fourth foot gained.
	Per cent.	*Per cent.*	*Per cent*	*Per cent.*
Above two lines of tile	2.1	+ 1.4	3.4	2.4
Eight feet from the two lines of tile	0.6	+ 1.3	4.1	3.1
Sixteen feet from the two lines of tile	1.6	— 0.5	3.5	0.3

A similar experiment was made with the straight line of tile 755 ft. long, running from the silt well of the main system to the outlet. "The experiment served to demonstrate that under certain conditions it would be possible to completely saturate a tile-drained field by pumping water through the main, allowing it to set back into the laterals and rise by hydrostatic pressure and capillarity to the surface."

These preliminary experiments conducted in 1893 were repeated in 1895 with a larger pump, which raised the water into a distributing reservoir, from which it was conveyed through a 5-inch sewer pipe to the drainage system. It was thus possible to measure with some definiteness the quantity of water used. After 2 preliminary experiments, more exact observations were made on the rate of percolation. This was found to be about 5 gal. per minute for each 100 ft. of tile for the whole system. To saturate the 5 acres it was necessary to pump into the drains 105,272 cubic feet of water, or enough to cover the area 5.8 in. deep.

In an experiment with irrigation tile laid at a depth of 18 in. in sandy reddish clay soil underlaid by coarse sand and gravel, the rate of percolation was 5.98 gal. per minute for 100 ft. of tile, the water being under considerable pressure.

In connection with this experiment the influence of surface irrigation and subirrigation on the growth of corn was also noted. The results are summarized in the following table:

Influence of irrigation on the growth of corn.

	Amounts of water.			Yields per acre.	
	In rain.	Applied.	Total.	Flint corn.	Dent corn.
	Inches.	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*
Not irrigated	8.15	....	8.15	7,916	7,426
Surface irrigated	8.15	8.61	16.76	11,080	9,625
Subirrigated	8.15	13.72	21.72	9,545	7,907

"One object of these experiments was to learn how much closer than the general practice of field planting corn may be grown provided ample water is furnished, and the results appear to warrant the conclusion that with more water supplied and less wasted a considerably closer stand and much larger yield may be had."

In these experiments, however, the unirrigated thick-seeded corn produced no ears, while the irrigated thick-seeded corn yielded as a rule small immature ears.

"*Cost of pumping water.*—In raising the water from the lake for these experiments a No. 4 centrifugal pump was used, driven by a common portable farm engine. The water was drawn through a 6-inch suction pipe 110 ft. long, raised to a height of 26 ft. and conveyed by gravity to the reservoir through a 6-inch galvanized iron conductor pipe.

"During 3 days the coal used in pumping was weighed and the amount burned on the 8th, 10th, and 11th of September was 1,865.1 lbs. of Indiana block, pumping with it 74,909 cu. ft. of water, or at the rate 80,320 cu. ft. per ton of soft coal, equal to 22½ acre-inches. Had we been provided with a larger discharge pipe and facilities for using water more rapidly than was possible at the time, the same amount of fuel would have been able to raise much more water than it did under the unfavorable conditions of the experiment."

The rate of percolation from long columns of soil, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 285–288, fig. 1*).—In continuation of investigations noted in a previous report,[1] tubes 8 ft. long and 5 in. in diameter were filled with water-free sand of different degrees of fineness, viz., that which passed screens with 20, 40, 60, 80, and 100 meshes to the inch, respectively. Each cylinder was filled with water from below until it overflowed at the top. The percolation from these cylinders during the period from January 30 to October 24 is recorded.

"The most remarkable feature of this experiment is the very long period during which the percolation continued, and not much less surprising is the irregularity with which it occurred. All of the cylinders discharged some water as late as July 13, after the lapse of 164 days, while one cylinder discharged 69.7 gm. of water on October 24, after a lapse of nearly 9 months. . . .

"After the first rapid percolation had taken place all samples of soil went on drying at nearly equal rates, each losing not quite 1 per cent of its dry weight, except the coarsest sand, which continued to percolate not only longest but also lost the largest amount of water during the latter interval, as it did during the first. . . .

"These observations have a very important bearing upon the irrigation of sandy lands, and show in an emphatic manner that it would be extremely wasteful not only of water but also of fertility to apply water in large quantities at a time, unless these lands are underlaid at a shallow depth with a much more impervious layer."

Results obtained in the culture of Swedish marsh lands, C. VON FEILITZEN (*Svenska Mossk. För. Tidskr., 1895, pp. 345–353*).—The author reviews the work of the Swedish Marshland Association during the past year. Excellent results were obtained in the culture of "high marshes" (sphagnum marshes). These marshes were tile drained and cultivated later in the season. During the winter months sand was spread on the drained marsh, followed in the spring by lime, Thomas slag, kainit, and about 46 bu. per acre of inoculated soil. The land may then be sown to peas, vetches, etc., or large crops of clover may be grown.

Kainit, in the author's experience, appears to have a marked effect against injurious insects. During the past year the grass plats experimented on were failures where Thomas slag was applied alone, while heavy yields were obtained on plats receiving kainit in addition to the slag.—F. W. WOLL.

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[1] Wisconsin Sta. Rpt. 1893, p. 175 (E. S. R., 7, p. 565).

The artesian waters of South Dakota, J. H. SHEPARD (*South Dakota Sta. Rpt. 1895, Bulletins, pp. 1–76, figs. 2*).—This is Bulletin 41 of the station (E. S. R., 7, p. 287) bound with the Annual Report.

Water analyses, E. E. SLOSSON (*Wyoming Sta. Rpt. 1895, Appen., pp. 99–141*).—A reprint of Bulletin 24 of the station (E. S. R., 7, p. 475.)

Analyses of water, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 122–125*).—Analyses with reference to potable qualities of 6 samples of spring, well, and artesian water are reported, together with analyses showing the fertilizing value of a sample of water used for irrigation, and the amounts of nitrogen in different forms in samples of rainwater collected at 13 different dates from July 19 to August 24. The average results of the analyses of the rainwater were as follows: Free ammonia 0.0289, nitrogen as nitrates 0.0096, and albuminoid ammonia 0.0213.

Bacteriological investigation of the Swiss mineral springs, J. WITTLIN (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 579–583*).

Destructive effects of winds on sandy soils and light sandy loams, with methods of prevention, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 292–326, figs 16.*)—A reprint of Bulletin 42 of the station (E. S. R., 6, p. 622).

Reclaiming peat marshes, F. H. KING (*Amer. Agr. (mid. ed.), 1896, July 25, p. 68*).

FERTILIZERS.

A soil test with fertilizers, H. P. ARMSBY (*Pennsylvania Sta. Bul. 35, pp. 25*).—An account is given of an experiment with potatoes, conducted by R. P. Lovett, jr., at Fallsington, Bucks County, Pennsylvania, on $\frac{1}{150}$-acre plats. Nitrate of soda, muriate of potash, and dissolved bone black were used singly, two by two, and all three together, and compared with no fertilizer.

It is stated that this experiment is reported by the station "both for its intrinsic interest and especially as illustrating a method by which, without much expenditure of time or money, the farmer may obtain information of great value to himself regarding his own soil."

The main results are as follows:

"A suitable combination of fertilizers as compared with an unsuitable one gave an increased profit per acre in 2 experiments of $47.24 and $54.71, respectively. . . .

"The use of nitrogen in a soluble form under favorable conditions paid an average profit of $5.44 per acre. Under unfavorable circumstances, no increased crop resulted and it was used at a financial loss of $7.14 per acre.

"Phosphoric acid without potash gave an increased profit per acre in 2 experiments of $2.90 and $7.72, respectively.

"Potash without phosphoric acid gave an increased profit per acre in the 2 experiments of $6.73 and $17.39, respectively.

"Phosphoric acid and potash used together gave an increased profit per acre in the 2 experiments of $40.17 and $51.02, respectively. In other words, neither the potash nor the phosphoric acid was able to produce its full effect except in the presence of the other, and the profit per acre arising simply from using the two together instead of separately amounted in the 2 experiments to $30.54 and $25.91, respectively.

"The average potato fertilizer sold in Pennsylvania, as compared with the home-mixed complete fertilizer used in these experiments, would have supplied but 44.4 per cent as much of the most needed element (potash), 148.8 per cent as much phosphoric acid, and 50 per cent as much nitrogen.

"It is practicable for the farmer to ascertain the needs of his soil as regards fertilizers by means of comparatively simple and inexpensive field experiments and thus to avoid wasting money in the unnecessary purchase of artificial fertilizers."

Commercial fertilizers and chemicals, R. T. NESBITT and G. F. PAYNE (*Georgia Dept. Agr. Bul. 32, pp. 132*).—This bulletin includes the text of the laws governing the inspection, analysis, and sale of commercial fertilizers, chemicals, and cotton-seed meal in Georgia, with rules and regulations prescribed by the Commissioner of Agriculture under the provisions of the laws; the report of the state chemist, including notes on the valuation of fertilizers, an explanation of terms used in fertilizer analysis, home-mixing of fertilizers, preparation of composts, and fertilizers from the farmers' standpoint; an article on fertilizers in Georgia during the year 1896; and tabulated analyses and valuations of 726 samples of mixed fertilizers, potash salts, natural phosphates, gypsum, and cotton-seed meal; besides articles on other subjects noted elsewhere (pp. 308, 331). The average composition of fertilizers sold in Georgia during the years 1874-'96 is shown in the following table:

Average composition of fertilizers sold in Georgia, 1874-'96.

	Available phosphoric acid.	Ammonia.	Potash.
For the season of—	*Per cent.*	*Per cent.*	*Per cent.*
1874-'75	9.23	2.55	5.17
1875-'76	10.94	2.53	2.49
1876-'77	10.87	2.52	2.75
1877-'78	11.43	2.79	2.23
1878-'79	11.95	2.70	1.66
1879-'80	10.24	2.58	1.33
1880-'81	10.96	2.53	1.41
1881-'82	10.88	2.48	1.47
1882-'83	11.03	2.53	1.50
1883-'84	10.82	2.47	1.55
1884-'85	11.13	2.24	1.44
1885-'86	11.01	2.43	1.65
1886-'87	11.39	2.45	1.94
1887-'88	11.66	2.46	2.12
1888-'89	11.48	2.80	1.94
1889-'90	11.46	2.75	1.97
1890-'91	11.30	2.54	1.89
1891-'92	10.90	2.40	1.70
1892-'93	10.81	2.32	1.85
1893-'94	10.92	2.51	2.02
1894-'95	10.65	2.39	2.23
1895-'96	10.89	2.28	2.14

Questions of manuring in the light of Wagner's researches, P. THIELE (*Fühling's landw. Ztg., 45 (1896), Nos. 13, pp. 407-414; 14, pp. 446-451*).

The relation of barn manures to soil temperature, J. TROOP (*Indiana Sta. Rpt. 1895, pp. 18, 19*).—Observations with soil thermometers at a depth of 4 in. in unmanured soil and in soil which had received a spring application of 25 tons of barnyard manure gave the following average results during 10 days: On the manured plat 70.6° F.; on the unmanured plat 65.7°.

The nitrogen and green manuring question, O. STILLICH (*Fühling's landw. Ztg., 45 (1896), Nos. 10, pp. 311-319; 11, pp. 344-353; 12, pp. 382-388; 13, pp. 420-424; 15, pp. 476-480; 17, pp. 549-553; 21, pp. 672-675*).—An account of the historical development of our present knowledge of the sources of nitrogen for plants.

Potato vines as a fertilizer, DENAIFFE (*Ind. Lait., 21 (1896); No. 37, pp. 290, 291*).

On liming, HOLDEFLEISS (*Mitt. deut. landw. Ges., 11 (1896), No. 13, pp. 143–145*).

Commercial fertilizers, H. A. HUSTON and W. J. JONES, Jr. (*Purdue University Special Bul., Aug., 1896, pp. 8*).—Brief statements regarding the fertilizer trade in Indiana and the quality of the fertilizers sold in that State during the year, with tabulated analyses and valuations of 397 samples of fertilizing materials.

Analyses of commercial fertilizers, M. A. SCOVELL, A. M. PETER, and H. E. CURTIS (*Kentucky Sta. Bul. 64, pp. 83–96*).—Tabulated analyses and valuations of 127 samples of fertilizing materials, accompanied by explanatory notes.

Analyses of fertilizers, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 117, 118*).—Tabulated analyses of 8 samples of wood ashes and 1 each of Orchilla guano, fine ground bone, sheep manure, and muck.

Fertilizer analyses, H. B. BATTLE (*North Carolina Sta. Special Bul. 38, pp. 4*).—Tabulated analyses and valuations of 49 samples of fertilizers.

Fertilizer analyses, H. B. BATTLE (*North Carolina Sta. Bul. 124, pp. 31*).—This is a summary (including tabulated analyses and valuations) of the work of the fertilizer control of North Carolina during the spring and fall of 1895.

FIELD CROPS.

Experiences in rational coffee culture, F. W. DAFERT (*Erfahrungen über rationellen Kaffeebau. Berlin: Paul Parey, 1896, pp. 36, figs. 8*).—This publication contains a short account of the experience in coffee culture of the Agricultural Institute of the State of Sao Paulo, in Campinas, in the years 1888 to 1895. The following topics are considered: The limits of yield of a coffee plantation, on what does it depend, and how can it be increased? Under the last head are included questions of manuring from a theoretical and practical standpoint.

The coffee tree begins to bear about the fourth year, reaches its maximum from the fourteenth to the eighteenth year, and then usually declines. The oldest tree known to the author has passed its sixtieth year without showing the appearance of old age, while others begin to decline from the twentieth to the thirtieth year. The yield per tree varies from $\frac{3}{4}$ lb. on an exhausted soil to 3 lbs. 15 oz. on a virgin soil, but these numbers may vary widely. The highest yield that so far has been observed with certainty on a large plantation is $16\frac{1}{4}$ lbs. per tree (average of 1,200 trees).

Cultivation of corn 3 inches deep compared with a less depth, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 266–284, fig. 1*).—During 4 consecutive seasons 13 experiments on the station farm and 7 in different portions of the State have been made, aiming to establish the best depth of stirring the soil in the cultivation of corn. The trial plats have consisted of alternate groups of 4 rows, one set cultivated 3 in. deep and the other $1\frac{1}{2}$ in. deep. The comparative yields were determined by weighing the whole product of the 2 middle rows of each group of 4, end hills being rejected. The rainfall for each season is given by months and each experiment described in detail with tabulated data.

The following table gives a summary of the results:

Percentage difference in yields of corn cultivated 3 in. and 1½ in. deep.

Location.	Depth of cultivation.		Location.	Depth of cultivation.	
	3 inches.	1½ inches.		3 inches.	1½ inches.
Experiment Station:	*Per cent.*	*Per cent.*	Experiment Station:	*Per cent.*	*Per cent.*
No. 1, 1891	0.76	....	No. 4, 1894	3.65	....
No. 2, 1891	.00	0.00	No. 5, 1894	....	2.98
No. 1, 1892	....	5.70	Milton	.63	....
No. 2, 1892	1.62	....	Fayetteville	8.81	....
No. 1, 1893	3.46	....	Grafton	4.32	....
No. 2, 1893	4.56	....	Stephensville	5.25	....
No. 3, 1893	11.41	....	Plainfield	....	24.29
No. 1, 1894	.43	....	Leeds	....	7.64
No. 2, 1894	3.43	....	Beaver Dam, 1893	10.26	....
No. 3, 1894	....	1.78	Beaver Dam, 1894	5.35	....

The author says: "It is here seen that of the 20 trials 14 are in favor of 3-inch cultivation and 5 in favor of the 1½-inch, while in the other the yields are equal."

These results are not in full accord with similar work at other stations, and the author concludes as follows: "It seems to be quite definitely settled that with rare exceptions a cultivation as deep as 4 inches is less productive than a shallower one. It seems also clear that the best depth to cultivate is not constant, either for soil or seasons. The problem is manifestly a complex one, and in view of the magnitude of the interests involved merits a more extended and careful study than it has yet received."

Effect of depth of cultivation on the water content of the soil (pp. 279–291).—This has been studied during three seasons. The water was determined in 1-foot sections at depths of 1, 2, 3, and 4 feet, the samples being "taken in the center between the 2 middle rows of each group of 4, and 2 adjacent groups of rows only have been compared." Where there was an appreciable slope of the surface from one group to another the samples from 2 groups of like cultivation on opposite sides and adjacent to the group with which they were compared were combined, giving their average water content.

The results are tabulated. The author concludes as follows:

"The results, covering 3 consecutive years and embracing 12 sets of determinations, each extending to a depth of 4 ft., taken in 7 different fields, show in a very conclusive manner that cultivation 3 in. deep does leave the ground more moist below the soil stirred than cultivation 1.5 in. deep. Indeed . . . there are only 2 cases in the surface foot and none in the second foot where the soil of the 3-inch cultivation is not more moist than the shallower depth, the average difference being 0.74 per cent for the first foot and 1 per cent for the second foot; and this means for the soils in question a difference of 1.5 lbs. of water to the square foot in the upper 2 ft. in favor of the 3-inch cultivation; and this difference has occurred, too, where, in the majority of cases, there has been a larger production of dry matter and presumably a larger consumption of water. . . .

"The data bring into strong relief another effect which has been referred to in earlier reports, namely, the translocation of soil moisture. . . . Of the 4 sets of

samples taken on July 16, 1894, from as many different fields, there is only one exception to the rule that while the surface 2 ft. of the 3-inch cultivation is more moist than the 1.5-inch cultivation the reverse of this is true of the third and fourth feet, these being dryer. The facts appear to be that while the surface 2 ft. of soil are more moist they are drawing water faster from the third and fourth feet than they could were they dryer."

Effect of deep and shallow cultivation on soil temperatures (pp. 283, 284).—During 1894 soil temperatures were taken to depths of 3 ft. in all the fields under experiment, with wholly concordant results, showing that the soil cultivated 1½ in. deep was warmer than that cultivated 3 in. deep, the mean difference being for the first foot 0.82° F.; second foot, 0.59° F.; third foot, 0.36° F. The differences were less than those recorded the previous season.

The diurnal changes of temperature at a depth of 1 ft. were also studied by means of 2 self recording thermometers.

"The mean daily changes during the week ending July 26 were for the 1½-inch depth 1.65° F. and for the 3-inch depth 1.45° F., making a difference in the diurnal range of 0.2° F."

Effect of previous manuring on yield of corn, W. C. LATTA (*Indiana Sta. Rpt. 1895, p. 38*).—On land continuously in corn fresh horse manure was applied to alternate plats in 1893 and 1894 at the rate of 50 tons per acre for the 2 years.

The increased yield attributable to residual effect of manure was 4 bu. per acre in 1895, and 123 bu. in the aggregate for 12 years.

Tests of forage grasses, G. MCCARTHY and F. E. EMERY (*North Carolina Sta. Bul. 125, pp. 37–54, 75–87, figs. 18*). This is a continuation of work published in Bulletin 98 of the station (E. S. R., 6, p. 34). Directions are given for the culture of grasses, and notes on the growth made by the following species and varieties grown on lowland and upland at the station:

Kangaroo grass (*Anthistiria ciliata*), tall oat grass, yellow oat grass, giant brome grass (*Bromus giganteus*), Hungarian brome grass, forest brome grass (*Brachypodium sylvaticum*), winged brome grass (*Brachypodium pinnatum*), star grass (*Chloris schwartziana*), mountain burr grass (*Cenchrus montanus*), meadow foxtail, perennial rye grass, Italian rye grass, orchard grass, timothy, redtop, fiorin, brown bent grass (*Agrostis canina*), bouquet grass (*Agrostis nubulosa*), Eaton grass, goose or mana grass, common sheep's fescue, red fescue, rose fescue (*Festuca heterophylla*), hard fescue, meadow fescue, tall fescue, soft velvet grass, mesquite or velvet grass, Johnson grass, reed grass, blue canary grass (*Phalaris cœrulescens*), Indian yard grass (*Eleusine flagellifera*), bitter grass (*Eragrostis pilosa*), heff grass (*Eragrostis abysinnica*), Kentucky blue grass, English blue or June grass, Texas blue grass, fowl meadow grass, wood meadow grass, fertile meadow grass, Palmer grass (*Panicum palmeri*), edible panic grass (*Panicum frumentaceum*), Louisiana grass, Japanese couch grass (*Agropyrum japonicum*), thatch grass (*Pennisetum longistylum*), teosinte.

Tobacco, test of fertilizers, M. A. SCOVELL and A. M. PETER (*Kentucky Sta. Bul. 63, pp. 61–68*).—Plat 1 received double superphosphate and nitrate of potash; plat 2, sulphate of potash; plat 3, no fertilizer; plat 4, carbonate of potash and magnesia; and plat 5, nitrate of potash. The

latter part of the season was unfavorable, and on none of the plats was the stand perfect. Both the actual yields and those corrected to a full stand are tabulated. According to the authors, the results indicate that a satisfactory yield of tobacco can be produced on the worn soils of Kentucky by applying potash fertilizers, and especially potash with nitrogen.

Analyses (fertilizer constituents) are tabulated of tobacco from each plat, of tobacco stems, and of tobacco grown elsewhere. They show that the tobacco raised on the experimental plats was much poorer in nitrogen, phosphoric acid, and especially in potash, than is usually the case.

Field experiments with tobacco, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 372–376*).—An experiment in irrigating tobacco was carried on during 1893 and 1894—both exceptionally dry seasons. In 1893 the first irrigation was made July 27, during the warmer part of the day, when the plants had a wilted appearance. The soil of the irrigated plat was saturated as deep as the plow line. The irrigation was repeated August 8. In 1894 but one irrigation was given, July 14. The gain in weight of cured leaf, presumably due to irrigation, was practically nothing in 1893, and 6.96 per cent in 1894.

One irrigation seemed to give better results than two. The author states that "from experiments thus far made it would appear that less profit is likely to accrue from the irrigation of tobacco than of strawberries."

In the investigation of the relation of distance in planting to yield and thickness of leaf, plants were set 20 by 31, 20 by 36, and 24 by 42 in., June 1 and 2, topped July 17 and 18, harvested August 18 and 20, and stripped during the week after November 3.

The following table gives the yields per acre, comparative weight of leaves, and area per pound of leaf:

Yield of tobacco grown at different distances.

	Yield per acre.	Weight of 400 average leaves.	Area per pound of leaf.
	Pounds.	*Pounds.*	*Square feet.*
3 ft. 6 in. by 2 ft	1,649.74	9.89	40.86
3 ft. by 1 ft. 8 in	1,886.53	8.79	42.11
2 ft. 7 in. by 1 ft. 8 in	2,084.18	9.46	42.01

The author concludes that "The closer planting was followed by a marked increase in yield; and closer planting in the row was followed by a thinner leaf, but lessening the distance between the rows was not."

Experiments in the curing and culture of tobacco, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 351–371, figs. 3, dgms. 4*).—To facilitate investigation in the curing of the crop a small curing house (28 by 32 ft.) was built, inclosed with close-fitted drop siding, divided into 4 compartments and furnished with ventilating doors and a central

ventilator; in the last a lighted lamp could be placed to assist in the ventilation. The results of curing tobacco hung in this building are tabulated.

The loss of water in curing was about 71 per cent of the weight of the green plant.

To investigate the conditions affecting the escape of water from the leaves, circular disks were cut between the veins in different stages of the curing, weighed, exposed for a given length of time to the air in an air-tight space, and again weighed. From 5 duplicate trials it appeared that the period of most rapid escape of water was when the color was changing from yellow to brown. The changes in color were not directly due to loss of moisture, the particular shade of brown depending largely upon the degree of ripeness.

An attempt was made to determine the highest degree of atmospheric moisture possible during the curing process without incurring an attack of pole burn, by employing a curing chamber in which the temperature and moisture could be controlled and kept uniform.

The chamber and the psychrometer used are described, and the results obtained in the curing tests are shown graphically.

The author says: "From these data the conclusion seems warrantable that with a temperature within the curing house of not exceeding 75° F., a degree of atmospheric humidity represented by a wet bulb depression of 2°, when the psychrometer is between the plants, and is not subject to unusual air currents, does not expose the tobacco to pole burn, and that an occasional variation to 1° is safe, at least if not prolonged. But a wet bulb depression of less than 1° is dangerous, and if prolonged is almost sure to result in pole burn." The water appears to be set free by the leaves rather than to be extracted from them by drying.

Pole burn is the decay of the leaf resulting from a too prolonged exposure to the excess of water within the substance of the leaf. It can be prevented by sufficient ventilation of the curing house.

Ventilation of the curing house (pp. 365–370).—A 6-inch hot-air flue placed a short distance above the floor was used, starting from a small stove at one side of the building, below the sill, and emerging on the same side a short distance above the sill, after traversing all the compartments. With this the humidity of the air was easily regulated. Four 36-inch box stoves, carrying 7-inch pipe, would be sufficient for a curing house 100 ft. long; the pipe should have an ascent of 10 in. to the rod.

Laths 4 or 5 in. apart and containing 6 medium plants are recommended.

"In curing tobacco the aim should be to have it cure in as moist an atmosphere as possible without incurring damage from pole burn."

Wheat, W. C. LATTA (*Indiana Sta. Rpt. 1895, pp. 35, 37, 40*).—This is a continuation of work published in Bulletin 56 of the station

(E. S. R., 7, p. 393). In 1895 thirty-seven varieties were grown, the yields ranging from 13 to 29 bu.; the average for 12 years has ranged from 17 to 29 bu. The more promising varieties were Jones Winter Fife, Rudy, and Velvet Chaff.

With 2 to 10 pecks of seed per acre, the range of yields in 1895 was 18 to 21 bu. The highest average yield was produced from 8 pecks per acre; the lowest from 2 pecks.

The yields of wheat sown at dates between September 18 and October 11 varied in 1895 from 7 to 19 bu., sowings September 18 to 20 giving the highest yield.

A report is given of a coöperative test of 4 varieties of wheat in 5 counties of the State.

Experiments with winter wheat, C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm Bul. 103, pp. 16, pls. 2*).—This is a report of a test of 81 varieties of wheat grown in 1896 compared in many cases with yields of former years. The largest yields per acre for 1896 were given by Imperial Amber, Russian Amber, Poole, Giant Square Head, Hunter Wheat, and New Columbia. Of the 81 varieties tested the 10 having the shortest heads produced an average of 11 bu. per acre more than the 10 having the longest heads. Notes on experiments in methods of culture favor sowing early in September, sowing with a drill, and 2 bu. of seed per acre. The largest yield of grain by measure and the best grain for seed were obtained from wheat cut later than the customary stage of ripeness.

Further notes on the milling qualities of different varieties of wheat, F. B. GUTHRIE and E. H. GUERNEY (*Agl. Gaz. N. S. Wales, 7 (1896), No. 2, pp. 103–106*).—Tabulated data are given for 33 varieties of wheat, showing yield of flour, "pollard" and bran, gluten in flour, and strength of flour, together with milling notes.

The authors conclude that wheat cut after a heavy rain has the milling qualities of soft wheat, weighs less, and the milling qualities are not so good. Wheat crossed with Fife showed the strongest flour among crossbred wheats, though not necessarily the highest gluten content. Blount Lambrigg was one of the best wheats in this series.

Effect of rotative cropping and continuous grain growing on yield, W. C. LATTA (*Indiana Sta. Rpt. 1895, pp. 38, 39*).—For 15 years corn, wheat, and oats have been grown without manure continuously or in alternation with one another, and in rotation with grass and clover, and all crops removed.

The average yield and increase per acre from rotation for the last 9 years are tabulated.

The average per cent of gain in yield from rotation between the rotative and all-grain series was corn 22 per cent; oats 19 per cent, and wheat 50 per cent.

Influence of the nature of the soil upon different crops, J. RAULIN (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 410–424, figs. 8*).

Cereals and other field crops (*Wyoming Sta. Rpt. 1895, Appen., pp. 63–73*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 210).

Cotton in British Central Africa (*Kew Misc. Bul. No. 113–114, pp. 118, 119*).—Brief notes are given of a semiwild cotton growing in Central Africa, the fiber of which is of a woolly character, from $1\frac{1}{8}$ to $1\frac{3}{16}$ in. long, but rather weak. It is rated as worth about $4\frac{1}{4}$ *d.* ($8\frac{1}{2}$ cts.) per pound in Manchester, England.

Flax fiber microscopically and chemically considered, A. HERZOG (*Die Flachsfaser in mikroskopischer und chemischer Beziehung. Trautenau: 1896, pp. 26, figs. 3*).—In this publication the author considers microscopically the flax stalk, the bast fibers of the flax, and the recognition of flax fibers in fabrics and papers. On the chemical side he treats of the water, crude fat, crude protein, crude fiber, ash, and the nitrogen-free extract of the flax fiber, also the bearing these considerations have on the preparation and use of the fiber.

Fiber flax in Washington, A. W. THORNTON (*Washington Sta. Bul. 20, pp. 11*).—This is a popular bulletin discussing the advisability of growing flax in the State and giving full directions for its culture.

Experiments with fiber plants (*Gard. Chron., ser. 3, 20 (1896), No. 515, p. 558*).—A brief account is given of experiments with sisal hemp in Egypt.

Tropical fodder grasses (*Kew Misc. Bul. No. 113–114, pp. 115–118*).—Notes and analyses are given of *Andropogon pertusus*, *A. caricosus*, *Chloris barbata*, *Panicum colonum*, and *P. prostratum*.

Forage plants (*Wyoming Sta. Rpt. 1895, Appen., pp. 60–63*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 209).

Fodder and forage plants exclusive of the grasses, J. G. SMITH (*U. S. Dept. Agr., Division of Agrostology Bul. 2, pp. 58, figs. 56*).—A popular bulletin on the subject, the species being arranged alphabetically according to the scientific names, with an alphabetical index of the English names appended. The remarks under each species, while brief, are designed to include the most important information of practical value. In the United States there are over 200 native or wild species of plants aside from grasses which are regarded as good forage plants. Among the wild native species mentioned by the author as worthy of more extended cultivation in regions where they thrive are wild vetch (*Hosackia purshiana*), deer weed (*H. glabra*), Beckwith clover (*Trifolium beckwithii*), Buffalo pea (*Astragalus caryocarpus*), winter fat (*Eurotia lanata*), and sotol (*Dasylirion texanum*).

Native and introduced forage plants in South Dakota, J. H. SHEPARD and T. A. WILLIAMS (*South Dakota Sta. Rpt. 1894, Bulletins, pp. 208, pls. 58*).—Bulletin 40 of the station (E. S. R., 6, p. 403) is bound with the Annual Report.

Some New Mexico forage plants, E. O. WOOTON (*New Mexico Sta. Bul. 18, pp. 57–95, pls. 12*).—A botanical description, with remarks on the economic value, is given of galleta grass (*Hilaria mutica*), joint grass (*Paspalum distichum* and *Eriochloa punctata*), barnyard grass, grapevine mesquite (*Panicum obtusum*), Texas drop seed grass (*Muhlenbergia texana* and *Lycurus phalaroides*), bunch grass (*Sporobolus airoides*), blue grama (*Bouteloua oligostachya*), six weeks grama (*B. polystachya*), woolly jointed grama (*B. eriopoda*), tall grama (*B. curtipendula* and *Eremochloe kingii*), salt grass (*Distichlis spicata*), millo maize, Kafir corn, Italian millet, pearl millet, alfalfa, mesquite (*Prosopis juliflora*), tornillo (*P. pubescens*), prickly pear, and sotol (*Dasylirion wheeleri*).

Forage plants with tabular résumé of their culture, P. MASSERON (*Bul. Agr. de l'Ouest, 1896, pp. 31*).

Guinea grass (Panicum maximum), J. H. HART (*Bul. Roy. Bot. Garden, Trinidad, 2 (1896), No. 8, pp. 219–221*).—Introduced into Jamaica as bird food. Cultural notes are given.

Grasses, W. C. LATTA (*Indiana Sta. Rpt. 1895, pp. 35, 36*).—Yields of hay per acre, calculated from fifteenth-acre plats, are tabulated for 8 varieties of grasses and 3 of leguminous plants. Alfalfa gave better results than any of the clovers in 1895. *Lathyrus sylvestris* is recommended only for light sandy and exhausted soils.

The formation and care of grass lands, G. McCarthy (*North Carolina Sta. Bul. 125, pp. 55–61*).—This is a popular article on the proper selection of species, manures for grasses, the use and value of experimental plats and grass mixtures, and the diseases and insect enemies of grasses. A tabulated statement is given of the percentage of nitrogen and ash constituents in different grasses. The author states that grass mildew (*Erysiphe graminis*) is the fungus that most commonly attacks the true grasses, for which air-slacked lime and sulphur are recommended as remedies. Their use, however, is restricted to lawns on account of the attendant expense.

The effect of well-kept grass land, long established, in giving stability to business, W. H. Brewer (*Connecticut State Bd. Agr. Rpt. 1895, pp. 16*).—This is a popular address on the method of starting, value, permanence, and beauty of long-established, well-kept grass land. The method described of propagation of the turf grasses is by separating the individual plants in a piece of turf, planting them with spaces between, and allowing each plant "to spread by sprouts from the root crowns until it forms a bit of turf of its own sort." The importance of the work of the Connecticut Station in this line is mentioned.

Improvement of the meadows of Campine and Ardenne, H. Vanderyst (*Bul. Agr. (Belgium), 12 (1896), No. 4, pp. 142–157*).—After a full discussion of the reasons for increasing the area devoted to meadows, the kinds and forms of manure to be applied, the little aid which a knowledge of the geological formation renders in solving this problem, and the amounts of fertilizing matter removed by a hay crop, the author takes up the different manures in detail, including nitrogen, lime, gypsum, magnesia, potash, and phosphoric acid. He considers it rarely advantageous to apply nitrogen to meadows. Nitrogen compounds accumulate in a sod. Lime neutralizes the organic acids and favors the formation of humus. Gypsum should not be employed in too large quantities nor too often. Applications of potash are needed in intensive culture, but in extensive culture they are of little advantage except on the Leguminosæ. Phosphoric acid is the most useful and indispensable element of fertility for meadows.

Haying tools and haymaking, F. E. Emery (*North Carolina Sta. Bul. 125, pp. 63–74, figs. 25, pls. 2*).—A popular article in which the common haying tools are described and figured, and practical directions given for haymaking.

Cultivation of broom millet for manufacturing purposes, A. A. Dunnicliff (*Agl. Gaz. N. S. Wales, 7 (1896), No. 9, pp. 627–631*).—Notes on the culture and varieties of broom corn.

Second crop of seed potatoes, J. Troop (*Indiana Sta. Rpt. 1895, p. 19*).—In a comparison of second crop with home-grown seed potatoes the former were ripe 10 days before the latter and produced 12 per cent more marketable potatoes.

Potatoes (*Wyoming Sta. Rpt. 1895, Appen., pp. 47–54*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 210).

An experiment in potato culture, Lilienthal (*Deut. landw. Presse, 23 (1896), No. 80, p. 721*).—A variety test in which Magnum Bonum was excelled by 6 sorts.

Irrigation of rice in South Carolina, W. F. Hutson (*Irrigation Age, 10 (1896), No. 4, pp. 124, 125*).

Root crops (*Wyoming Sta. Rpt. 1895, Appen., pp. 54–60, pl. 1*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 203).

Coöperative test of sugar beets, I. P. Roberts (*New York Cornell Sta. Rpt. 1894, Appen., pp. 39–44*).—A reprint of Bulletin 63 of the station (E. S. R., 5, p. 979).

Notes on the color of the grain in different varieties of wheat, N. A. Cobb (*Agl. Gaz. N. S. Wales, 7 (1896), No. 8, pp. 517–520*).—Fifty-six varieties of wheat are arranged in reference to their color. The author states that a dry season produces light-colored grain and a wet season dark colored.

Wheats which give large yields, L. Caillé (*Prog. Agr. et Vit., 26 (1896), No. 43, pp. 467–469*).—The author comments on 4 varieties of wheat—Gatelier, Rieti, Rodet, and Blé de Pays—which yielded 37, 36, 29, and 28 hectoliters, respectively, per hectare. Cultural directions are given.

The properties and conditions of production of fine brewing wheat (*Fühling's landw. Ztg., 45 (1896), No. 21, pp. 683–686*).

Results of three years' experiments in cost and profit of growing wheat, B. C. BUFFUM (*Wyoming Sta. Rpt. 1895, Appen., pp. 147–154*).—A reprint of Bulletin 25 of the station (E. S. R., 7, p. 578).

Wheat culture at the experiment station of Capelle, F. DESPREZ (*Jour. Agr. Prat., 60 (1896), II, No. 39, pp. 466–469*).—Cultural notes are given on 4 square-head varieties, Dattel, and Jaune a Epi rouge.

Crops at the Divide Substation, J. H. MCCLELLAND (*Colorado Sta. Rpt. 1895, pp. 123–136*).—A report on the culture of wheat, oats, and barley, flax, broom corn, buckwheat, grasses, and other forage crops in plats, *Bromus inermis*, alfalfa, and potatoes. "The conditions were favorable for early oats and for hay; but late oats and potatoes made poor yields." Very brief notes are also given upon condition of the orchard and garden.

Grain, forage crops, and root crops at the Rain-Belt Substation, J. B. ROBERTSON (*Colorado Sta. Rpt. 1895, pp. 137–142*).—Four varieties of wheat, 2 of oats, 3 of barley, 1 of rye, 1 of field peas, and 6 of corn were sown; also Kafir and Jerusalem corn, Red Amber sorghum, and broom corn. Drought, chinch bugs, and early frosts prevented the crops from maturing.

Report of the Arkansas Valley Substation, P. K. BLINN (*Colorado Sta. Rpt. 1895, pp. 143–152*).—Five varieties of winter wheat, 1 of spring wheat, 1 each of oats, rye, and buckwheat, and 3 of corn were planted; also 73 acres of alfalfa, and 3 of red clover. Of the 3 cuttings of alfalfa the first, 153.29 tons, cost $1.15 per ton for harvesting; the second, 83.9 tons, $0.95 per ton; and the third, 74.2 tons, $0.99 per ton. Notes are also given upon culture of sugar beets, potatoes, sweet potatoes, vegetables, and fruits at the station.

Grain, forage, and root crops, and garden at the San Luis Valley Substation, C. A. DUNCAN (*Colorado Sta. Rpt. 1895, pp. 153–161*).—Variety tests were made of 6 varieties of wheat, 5 of oats, and 15 of potatoes. Barley, Polish wheat, and field peas were also sown. Wheat yielded from 14 to 20 bu. per acre, oats 23½ to 30 bu., and potatoes 90 to 152 bu. No detailed results are given of vegetable culture.

Grain, root, and forage crops in South Dakota, E. C. CHILCOTT (*South Dakota Sta. Rpt. 1894, pp. 10–17*).—Thirty-seven varieties of wheat, 14 of barley, 11 of oats, and 120 of potatoes were grown. Indian corn failed, owing to the unfavorable season. Jerusalem corn, Kafir corn, brown durra, millow maize, and dwarf Essex rape were also grown.

The profitableness of an extensive and an intensive system, W. LILIENTHAL (*Deut. landw. Presse, 23 (1896), No. 85, pp. 757, 758*).

Experiments at Borsbeke-lez-Alost, results obtained in 1895, P. DE VUYST (*Rev. Agron., 5 (1896), No. 1, pp. 1–22*).—This report covers experiments with manures on winter wheat, rye, oats, clovers, and meadows; a comparison of different phosphates; and a comparison of the waste from excelsior with straw for bedding.

Report on experiments in culture made in 1895 at the School of Agriculture of Carlsbourg, F. MATHIAS (*Bul. Agr. (Belgium), 12 (1896), No. 4, pp. 134–141*).—This gives the results of experiments in the analysis of the soil by the plant, of experiments with the sugar beet, and of experiments undertaken with the object of comparing the effects of different phosphates on a moist meadow.

HORTICULTURE.

The ash analysis of the watermelon, giving the mineral substances it takes from the soil, G. F. PAYNE (*Georgia Dept. Agr. Bul. 32, pp. 29–31*).—Two medium-sized watermelons were found to contain

0.3338 per cent of ash, calculated free from carbonic acid. The composition of watermelon ash is as follows:

	Per cent.
Sulphuric acid	4.41
Calcium oxid	5.54
Magnesium oxid	6.74
Potassium oxid	61.18
Sodium oxid	4.31
Silicon dioxid	2.15
Phosphoric acid	10.25
Chlorin	4.94
Iron sesquioxid	.48
Total	100.00

On this basis the author calculates that a crop of melons weighing 39,766 lbs. per acre, "which is an unusually large one," would take from the soil 81.09 lbs. of potash and 13.59 lbs. of phosphoric acid. This would be replaced by 100 lbs. of acid phosphate, containing 13 per cent of phosphoric acid, and 160 lbs. of muriate of potash. One-half a car load of melons per acre, or about one-third of the above crop, is said to be a fair crop on good land.

Flowering and fertilization of native plums, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 347-350*).—The native plums are very uncertain in fruitage and the author made a careful study of the flowers of the varieties of plums growing at the station in the hope of discovering some of the reasons for the failure of the blossoms to produce fruit. Thirty-four varieties were examined and it was found that the native species had decidedly more slender styles and smaller stigmas than those of the European plum, and that these slender styles were often broken or bent by rain. The author thinks, however, that this would not be likely to cause failure in pollination, since all varieties appear to produce abundant pollen, the anthers of the same flower rarely mature at the same time, and the flowers on a given tree usually have a range of several days in time of opening.

The percentage of perfect pistils found varied from 29 in the Moreman plum to 100 in the White Nicholas. The proportion of flowers that formed fruits in the different varieties corresponded with the percentage of perfect flowers, but by the time the plums had grown to the size of an apple seed or a little larger a large proportion of them dropped from the trees of some varieties having a high percentage of perfect flowers. "The dropping of the miniature fruits was sometimes most marked in the varieties that apparently possessed the most robust pistils." White Nicholas blossomed freely and had 100 per cent of perfect pistils, but only two or three fruits grew to maturity.

"These observations indicate that the failure of blossoms to set fruit in our native plums is probably due to more than one cause, and that while they do not show that the failure is never due to a lack of pollen

it seems probable that it more often results from a deficiency of pistils or from cold weather during the period of fertilization."

Experiments in strawberry culture, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 327–339, figs. 5*).—The plants under trial were set out on a light clay loam in the spring of 1892, 2 ft. apart in rows 3½ ft. apart and usually 50 ft. long. They were allowed to form matted rows, given good culture and a fair allowance of stable manure, and were well protected during the winter. The results given are averages of crops of 1893 and 1894.

Test of varieties (pp. 327–330).—Only such varieties were planted as seemed for special reason to merit trial. The results are given in graphic form for 45 varieties tested, Warfield, Enhance, Bederwood, Parker Earle, and Boynton leading in productiveness in the order named. The length of fruiting season of these varieties is shown graphically, the season extending from June 12 to July 5.

Test of keeping quality (pp. 330–332).—In 1893 sample boxes of the freshly picked berries of the different varieties were placed on a shelf in a north room, and examined and classified after 24 and 48 hours. At the end of the test 12 varieties were still in a fair salable condition, 20 still usable, and 9 unfit for use. The three varieties leading in productiveness were among those in the first class, Parker Earle and Boynton being in the second class.

Irrigation (pp. 332–337).—The irrigation apparatus used by the station in 1894 consisted of an ordinary threshing engine and rotary pump for raising the water from the lake and forcing it to the strawberry plantation through a 2½-inch pipe, and V-shaped wooden troughs supported on crossed stakes. These troughs extended across the rows and had openings guarded by simple homemade galvanized iron gates by which the water could be let into furrows between the rows. The beds were irrigated June 11, when there had been no rain for 18 days. The plants were just beginning to show the effect of drought but "resumed their fresh and vigorous appearance and yielded a fine crop of excellent fruit." Rain on June 16 rendered further irrigation unnecessary, but the irrigated and check plats showed yields of 496.6 and 252.8 quarts, respectively, thus indicating a gain of 243.8 quarts for the one irrigation even when followed by rain. As a result of after-harvest irrigation upon a plantation that had borne two full crops and had been mowed and burned over and thinned out "the plants made a most vigorous growth . . . looking far more promising than spring-set beds that had not been irrigated, [while] the check rows were nearly ruined, long vacant spaces appearing whence every plant had perished from the protracted drought."

Breeding experiment (pp. 337, 338).—This is in continuation of work reported in the Annual Report of the station for 1892 (E. S. R., 5, p. 496). In the spring of 1892 2 rows of 25 plants each of Wilson strawberries were set, the plants being "grown from other plants set the

preceding spring, and which had consequently not borne fruit" and of which "the ancestors had been grown for many successive generations in the manner described. . . . One row was planted with the same variety, but with plants taken from a bed that was known to have borne two crops, and which was originally planted from a bed known to have borne one crop."

The two rows contained in the spring of 1893 an average of 19.3 plants for each one originally set, and the single row contained an average of but 13.3 plants for each set. The difference in fruit production was not so marked, perhaps, because of overcrowding in the more vigorous rows.

In the spring of 1893 one row of 25 plants was set from a strain of Wilson strawberry, which had been diminished in vigor by "spot disease," and another row from the healthy strain so long propagated from young plants. In 1894 the latter row had produced almost twice as many plants as the former, and yielded nearly twice as much fruit.

An unsuccessful attempt was made to control "spot disease" (*Ramularia tulasnei*) by use of Bordeaux mixture, four applications being made to half of an affected plat, "but not the slightest difference was discernible between the sprayed and unsprayed parts."

Fruit brevities, L. H. BAILEY (*New York Cornell Sta. Bul. 117, pp. 351–396, figs. 18*).—This consists of several short articles on horticultural subjects, none of which is considered of sufficient length to justify separate publication.

Packing houses for fruit (pp. 351–361).—This discusses the packing of fruit, especially apples and grapes, in the State. Two styles of packing houses are commonly employed, one furnished with a basement or cellar for storage of the fruit, and the other being a packing house only, without cellar. The methods of sorting and packing grapes and apples are described and illustrated from photographs. The forms of different grape-packing tables, one of which revolves on a central pivot, are figured. The methods followed by different packers are quoted from their replies to inquiries.

History of the Ohio raspberry (pp. 361–365).—This discusses the variety Ohio at some length, and shows that it is not the variety Ohio Everbearing of various horticultural books. The present variety Ohio was originated about 30 years ago, probably in the State of that name.

The "mistletoe disease" of the blackberry (pp. 365–367).—Brief notes upon an affection of blackberry canes in which small, dense bunches of foliage occur, accompanied with curling of the shoots. The malformation is caused by a psylla known as the blackberry flea louse (*Trioza tripunctata*). Cutting out and burning the infested tips as soon as discovered is recommended as the best remedy, although spraying with kerosene emulsion will keep the psylla in check.

Root galls (pp. 367–375).—This treats of irregular excrescences on the roots of fruit trees, or on the main stems just below the ground. The size varies from that of a pea to several inches in diameter. Several authors are quoted to show the varying opinions as to the nature of such galls which are not believed to be due to the attack of any organism, plant, or animal, but rather consisting of malformation following some injury of the root or uncongenial condition in soil or treatment. As the galls may seriously interfere with the nutrition of the tree, the cutting off of all galls when nursery stock is planted is recommended.

Are dewberries worth growing (pp. 375–383)?—This consists of information supplementary to Bulletin 34 of the station (E. S. R., 3, p. 523). The varieties Lucretia and Bartel are considered the most desirable of the several varieties that have been introduced. The Lucretia dewberry in particular is recommended on account of its earliness, and if given careful culture and trained on stake or wire trellis it is believed to be a profitable fruit.

The goumi (pp. 383, 384).—A brief descriptive account of *Elæagnus longipes*, citing its botanical characteristics and horticultural possibilities. The bush is hardy in western New York and yields such abundant crops of red gold-flecked berries of agreeable piquant flavor that the extensive cultivation of the plant is recommended.

The winter injuries (pp. 385–392).—This briefly recounts the effects of the winter of 1895 upon vegetation throughout the State, much injury being done. All stone fruits were especially injured, pears also suffering. It is thought that the injury produced by the cold weather was augmented by the drought of the preceding summer, by means of which the trees were weakened in vitality, and the dryness of the ground prevented the trees making up the moisture evaporated during the winter season. Cut twigs were placed in living rooms to ascertain the loss by evaporation. During the 3 days occupied in the experiment the rate of evaporation was constant, averaging ½ cgm. per hour. Notes are given on the condition and injuries of peaches, pears, plums, apricots, dwarf cherries, chestnuts, and walnuts.

Crimson clover in orchards (pp. 392–396).—This cites experiments with crimson clover to ascertain its hardiness and value as a green manure crop in orchards. Crimson clover is recommended only for orchards and not for forage or hay crops, the common clovers, spring-sown, being more useful for this purpose. It is believed that if crimson clover is sown the last of July or first of August the best results will be produced. The ground should be prepared by previous pulverizing.

Onions, B. C. BUFFUM (*Wyoming Sta. Rpt. 1895, Appen., pp. 31–46, pls. 2*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 211).

Garden peas, B. C. BUFFUM (*Wyoming Sta. Rpt. 1895, Appen., pp. 159–167*).—A reprint of Bulletin 26 of the station (E. S. R., 8, p. 48).

Squashes, L. C. CORBETT (*South Dakota Sta. Rpt. 1895, Bulletins, pp. 77–92, figs. 2*).—Bulletin 42 of the station (E. S. R., 7, p. 403), bound with the Annual Report.

Tomatoes, L. C. CORBETT (*South Dakota Sta. Rpt. 1894, Bulletins, pp. 16*).—Bulletin 37 of the station (E. S. R., 6, p. 51), bound with the Annual Report.

Truffles of Greece, A. CHATIN (*Compt. Rend., 123 (1896), No. 14, pp. 537–541*).—Several sorts of truffles are described.

Yams (Dioscorea spp.), J. H. HART (*Bul. Roy. Bot. Gardens, Trinidad, 2 (1896), No. 8, pp. 206–212*).—Several species of Dioscorea are cultivated under the name of yam, of which the author mentions 5 with varieties under each. The yield at the Gardens was at the rate of 23,600 lbs. per acre.

Vegetables in Washington, J. A. BALMER (*Washington Sta. Bul. 19, p. 20*).—This bulletin comprises cultural and comparative notes on 19 varieties of cabbage, 22 of onions, 26 of peas, 10 of cauliflower, 10 of celery, 6 of sweet corn, 2 of Lima beans, 12 of beets, 2 of spinach, 10 of carrots, 7 of turnips, 3 of okra, 3 of rhubarb, 14 of squashes, 15 of tomatoes, and 45 of potatoes, and on one or more varieties of broccoli, cardoon, lentils, leeks, kohl-rabi, radishes, parsley, chicory, brussels sprouts, lettuce, watermelons, muskmelons, eggplants, and tobacco. The majority of the vegetables thrived well and gave crops of good quality, but watermelons, muskmelons, peppers, eggplants, and tomatoes are regarded as failures in this region. Peas, beans, root crops, and potatoes gave particularly fine results. Brief directions for the care and cultivation of the vegetable garden are appended.

Some recent Chinese vegetables, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 177–201, pls. 2, figs. 9*).—A reprint of Bulletin 67 of the station (E. S. R., 6, p. 217).

Apricot growing in western New York, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 271–292, figs. 11*).—A reprint of Bulletin 71 of the station (E. S. R., 6, p. 420).

The native dwarf cherries, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 259–265, figs. 5*).—A reprint of Bulletin 70 of the station (E. S. R., 6, p. 421).

Impressions of the peach industry in western New York, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 361–386, pl. 1, figs. 12*).—A reprint of Bulletin 74 of the station (E. S. R., 6, p. 545).

A dwarf stock for the peach, E. S. GOFF (*Garden and Forest, 9 (1896), No. 454, p. 448*).—Notes are given on the use of *Prunus japonica*, *P. besseyi*, *P. subcordata*, and a dwarf form of *P. maritima*. The peach buds failed to form a union in the first case, the others being still under investigation.

The American persimmon, C. S. PLUMB (*Garden and Forest, 9 (1896), No. 454, pp. 442, 443*).

The Japanese plums in North America, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 1–36, pls. 3, figs. 12*).—A reprint of Bulletin 62 of the station (E. S. R., 5, p. 983).

The quince in western New York, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 609–631, pls. 2, figs. 10*).—A reprint of Bulletin 80 of the station (E. S. R., 6, p. 899).

Orchard fruits for family and market, H. E. VAN DEMAN (*Rural New Yorker, 55 (1896), No. 2438, pp. 686, 687.*)

Notes on orchard fruits, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 343–347*).—Brief descriptions and notes upon value of seedlings and new varieties of plum and apple.

Hints on the planting of orchards, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 242–254*).—A reprint of Bulletin 69 of the station (E. S. R., 6, p. 420).

The cultivation of orchards, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 297–314, pl. 1*).—A reprint of Bulletin 72 of the station (E. S. R., 6, p. 546).

Strawberry culture under irrigation, F. C. BARKER (*Irrigation Age, 10 (1896), No. 4, pp. 131, 132*).

Varieties of the strawberry, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 583–600, 602, 603, pl. 1, figs. 9*).—A reprint from Bulletin 79 of the station (E. S. R., 6, p. 901).

Small fruits at Laramie (*Wyoming Sta. Rpt. 1895, Appen., pp. 80, 81, pl. 1*).—Reprinted from Bulletin 22 of the station (E. S. R., 7, p. 215).

The grafting of grapes, E. G. LODEMAN (*New York Cornell Sta. Rpt. 1894, Appen., pp. 459–476, figs. 16*).—A reprint of Bulletin 77 of the station (E. S. R., 6, p. 724).

Fruits and their preservation for exhibition purposes, G. F. PAYNE (*Georgia Dept. Agr. Bul. 32, pp. 17–19*).—This is a reprint from the *Druggists' Circular*. The author recommends the use of a solution of the same specific gravity as the juice of the fruit for the preservation for exhibition purposes. The average specific gravity of the juice of a number of fruits is given, and several formulas for the preparation of preservative solutions.

Five ornamental oaks, S. C. MASON (*Garden and Forest, 9 (1896), No. 453, pp. 432, 433*).—Notes are given of 5 species of oak adapted to street and park planting in Kansas. They are *Quercus rubra*, *Q. velutina*, *Q. palustris*, *Q. imbricaria*, and *Q. phellos*.

Conifers on the grounds of the Kansas Agricultural College, II, F. C. SEARS (*Garden and Forest, 9 (1896), No. 456, p. 462*).—*Pinus strobus* has not proved an entire success, *P. pungens* appears to be perfectly hardy, and *P. humilis* is valuable for ornamental purposes.

The cultivated poplars, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 205–238*).—A reprint of Bulletin 68 of the station (E. S. R., 6, p. 425).

Bacteria in gardening (*Gard. Chron., ser. 3, 20 (1896), No. 514, pp. 528–530*).—Editorial mention is made of Dr. Voelcker's report on "Nitragin" with a brief account of experiments begun in England.

Utilizing coal ashes, W. E. BRITTON (*Garden and Forest, 9 (1896), No. 453, pp. 434–436*).—Notes are given on the use of coal ashes in horticultural and other practice.

Notes on ornamental trees and shrubs, E. S. GOFF (*Wisconsin Sta. Rpt. 1894, pp. 340–342*).—Notes are given as to the hardiness of the purple leaf plum (*Prunus pissardii*), ginkgo or maidenhair tree (*Salisburia adiantifolia*), Teas weeping mulberry (*Morus alba*), amure tamarisk (*Tamarix amurensis*), golden elder (*Sambucus nigra* var. *aurea*), golden-leaf syringa (*Philadelphus coronarius*), *Deutzia crenata*, and *D. gracilis*, *Viburnum plicatum*, *Eleagnus longipes*, *Rosa rugosa*, Van Houtten's spiræa (*Spiræa van houttei*), large panicled hydrangea (*Hydrangea paniculata grandiflora*), yellow wood (*Cladrastis tinctoria*), Japan ivy (*Ampelopsis tricuspidata*), *Abies concolor*, and *Picea englemanni*.

FORESTRY.

The Douglas fir (*Gard. Chron., ser. 3, 20 (1896), No. 509, p. 371*).—Notes are given on the growth of this tree in Great Britain and on the Continent.

Silver maple, white maple, or soft maple, J. T. ROTHROCK (*Forest Leaves, 5 (1896), No. 11, pp. 168, 169, pls. 2*).—Notes are given on *Acer dasycarpum*.

The red or Norway pine, J. T. ROTHROCK (*Forest Leaves, 5 (1896), No. 10, p. 152, pls. 2*).—Notes on *Pinus resinosa*.

Product of white pine per acre, E. HERSEY (*Garden and Forest, 9 (1896), No. 450, pp. 402, 403*).

An experimental grove of white pine, J. D. LYMAN (*Garden and Forest, 9 (1896), No. 449, pp. 392, 393*).

Pruning timber trees, A. C. FORBES (*Gard. Chron., ser. 3, 20 (1896), No. 508, p. 333*).—The desirability of pruning forest trees is pointed out, and attention called to the liability to fungus attacks where the pruning is not properly done.

The removal of dead leaves from forests, A. VISART (*Bul. Soc. cent. Forst. Belgique, 3 (1896), No. 9, pp. 612–650*).—A report is given by a commission appointed by the Minister of Agriculture to investigate the effect of removing dead leaves from forests and in general the practice is condemned.

What kind of trees to plant in the Middle and New England States (*Forest Leaves, 5 (1896), No. 11, pp. 172, 173*).—The trees recommended for forest planting in

the region indicated are white pine, red cedar, jack pine (*Pinus rigida*), bald cypress, white cedar, spruces, hemlock, white oak, chestnut, hickory, and black oak. A list of secondary value includes the locust, rock oak, sugar maple, beech, birch, and cherry.

Forest studies in Minnesota (*Garden and Forest, 9 (1896), No. 451, p. 412*).—An editorial note is given of proposed studies to be undertaken by the University of Minnesota on second growth timber on stump lands.

A new fir from Arizona, C. H. MERRIAM (*Proc. Biol. Soc., Washington, 10 (1896), pp. 115–118, figs. 2*).—*Abies arizonica* n. sp. is figured and described. So far as known this tree is confined to the San Francisco and Kendrick Mountains in Arizona.

Facts gathered by observation and experience relating to the white pine, E. HERSEY (*Bul. Bussey Inst., 2 (1896), pt. 5, pp. 373–385*).—Notes are given relative to the rate of growth of *Pinus strobus*.

Willow culture, L. PICCIOLI (*La cultura dei salicio. Firenze: S. Landi, 1896, pp. VII, 247, figs. 46; abs. in Allg. Forst. und Jagd. Ztg., 1896, pp. 321, 322*).

The Canada poplar in Belgium (*Bul. Soc. cent. Forst. Bélgique, 1896, Oct., pp. 696–699*).

Native shrubs and trees of South Dakota, T. A. WILLIAMS (*South Dakota Sta. Rpt. 1895, Bulletins, pp. 93–123*).—Bulletin 43 of the station (E. S. R., 7, p. 507) is bound with the Annual Report.

Forestry, L. C. CORBETT (*South Dakota Sta. Rpt. 1895, Bulletins, pp. 127–151*).—Bulletin 44 of the station (E. S. R., 7, p. 507) is bound with the Annual Report.

Tree growth, A. C. FORBES (*Gard. Chron., ser. 3, 20 (1896), No. 513, p. 502*).—Notes are given of the relation of flow of sap to growth, and the statement is made that a larch trunk cut during the summer and branches trimmed off continued to make considerable additions to the year's ring of wood.

Growth of trees in New Zealand, T. W. ADAMS (*Gard. Chron., ser. 3, 20 (1896), No. 512, p. 458*).—Tabulated information is given as to the growth of more than 80 species of artificially planted trees.

Reforesting waste lands in Holland, J. GIFFORD (*Garden and Forest, 9 (1896), No. 452, p. 423*).

Draining woodlands, A. C. FORBES (*Gard. Chron., ser. 3, 20 (1896), No. 511, pp. 428, 429*).

The forests in the vicinity of Crater Lake, Oregon, F. V. COVILLE (*Forest Leaves, 5 (1896), No. 11, p. 163*).

Interesting foreign trees for propagating in France, P. MOUILLEFERT (*Jour. Agr. Prat., 60 (1896), II, No. 39, pp. 454–460, figs. 4*).

The practical value of forestry to the surface of the country, F. H. HAIN (*Forest Leaves, 5 (1896), No. 10, pp. 154–156*).

DISEASES OF PLANTS.

Bordeaux mixture, its chemistry, physical properties, and toxic effects on fungi and algæ, W. T. SWINGLE (*U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 9, pp. 37*).—The author presents a summary of our present knowledge regarding this valuable fungicide, and draws conclusions from his own and others' observations in which he points out lines of work whose further investigation is thought to be desirable.

Freshly made Bordeaux mixture is said to consist essentially of cupric hydroxid and calcium sulphate in solid form, suspended in a nearly or quite saturated solution of calcium sulphate and calcium hydroxid in water. The most soluble constituents are calcium sulphate and calcium hydroxid, which are present in considerable amount

where there is an excess of lime. Probably no cupric hydroxid or other copper salt is present in solution where the mixture is properly made. The cupric hydrate in freshly made Bordeaux mixture is in the form of precipitation membranes, probably of a colloid nature, containing large quantities of imbibed water. Upon standing, especially if the mixture is agitated occasionally, the precipitation membranes disappear and are replaced by crystals of copper hydroxid. The crystals are often in the form of sphærocrystals. The calcium sulphate is thrown down in the form of amorphous granules which upon standing often appear as twin crystals.

The character of the cuticle of the plant, whether easily wetted or not, and fineness of the spray are factors which influence the adherence of the mixture. Upon the evaporation of the mixture the calcium sulphate crystallizes out, cementing the precipitates together and to the leaf. The calcium hydroxid, by absorbing carbon dioxid from the air, gradually changes to calcium carbonate, which being very difficultly soluble aids in cementing the precipitates to the leaf. The colloid precipitation membranes by drying also aid in fixing themselves to the surface of the leaf. Through the adhesiveness and difficulty of solution of the cementing substances the great adhesiveness of Bordeaux mixture is secured.

The cupric hydroxid is not dissolved until the calcium hydroxid has been changed into a carbonate through the action of rains, dew, and moist air. Small amounts may be dissolved by the carbon dioxid of the air, ammonium carbonate, nitrate, and nitrite, together with substances absorbed from the cells of the host, or possibly by substances secreted by the fungus. The action of copper upon the germination of various fungus spores and upon algæ as reported by various observers is given, in which it is shown that many of them are very susceptible to extremely dilute solutions. The following suggestions are given regarding the possible action of copper on fungi:

"(1) The spores may be prevented from germinating by inhibitory action; (2) the protoplasmic content of the spores may be killed outright in a short time before germination has commenced; (3) through negative chemiotropic action of the copper hydroxid the germ tube may be prevented from entering the plant; (4) the germ tube may be so weakened by copper in solution as to be unable to enter the host plant; (5) the germination tubes may be prevented from growing or be killed only upon contact with solid particles of copper or its compounds, or with the cuticle or other parts of the host impregnated with copper; (6) the germ tube may be so much injured soon after germination as to cease growing before attempting to effect an entrance into the host plant, or may be killed outright soon after appearing; (7) the effect of the copper contained in Bordeaux mixture may be exerted at a later stage of development of the fungi; (8) the presence of a thick coating of copper salts might impede the fruiting of a fungus already within the tissues of the host plant."

Report of the botanical department, J. C. ARTHUR (*Indiana Sta. Rpt. 1895, pp. 21–28*).—Among the most important investigations carried on during the year were pot experiments with fertilizers on

different types of soils. It is expected to publish soon some of the results obtained. Corn smut was also studied, and it was found that the spores are able to germinate as soon as they mature, in this way rapidly disseminating the disease. Germination can be largely prevented by spraying the plants with Bordeaux mixture, but the economic phase of the subject remains to be studied.

The study of potato scab was continued, the results of which were given in Bulletin 56 of the station (E. S. R., 7, p. 408). Considerable attention has been given the subject of weeds. In this connection it was found that the two seeds in the cockle bur germinate at different times. The cause of this difference in the activity of the two seeds is to be given in a future bulletin.

Report of the botanist, A. D. SELBY (*Ohio Sta. Rpt. 1895, pp. XXXIV–XLII, maps 2*).—The work of the past year has been concerned principally with investigations on plant diseases and on weeds.

The study of peach diseases revealed the presence in the State of peach leaf curl, yellows, fruit spots, peach rot, root or crown gall of peach, and a twig spot, and incidentally the presence of the root aphis (*Aphis persicæ niger*). A Bordeaux mixture containing 2 lbs. of copper sulphate to 50 gals. of water was found not to injure the peach foliage. In spraying experiments with this solution it was found to be very efficient in combating the brown or pustular spot of the fruit.

The operation of the law relative to black knot and yellows disclosed the distribution of the latter disease, and its spread is shown by a map. Suggestions are offered for the prevention of these diseases and for the better enforcement of the law.

Investigations on grain smuts were carried on, the results of which were incorporated in Bulletin 64 of the station (E. S. R., 8, p. 238).

The study of weeds was continued throughout the year. In response to the inquiry in Bulletin 59 of the station (E. S. R., 7, p. 690), relative to occurrence and distribution of weeds, numerous replies and many specimens were received. The occurrence of the more noxious weeds is shown by a map on which is platted the distribution of the Russian thistle, horse nettle, buffalo bur, field peppergrass, pennycress, bracted plantain, spiny amaranth, spiny clot bur, and golden hawkweed. The detailed responses await publication.

On the appearance of a new potato disease, C. SAJO (*Ztschr. Spiritusindustrie, 19 (1896), No. 33, p. 263*).

Observations on combating the heart and dry rot of beets (*Neue Ztschr. Rubenz. Ind., 37 (1896), No. 13, pp. 157–159*).

Concerning methods for preventing heart and dry rot of beets (*Fühling's landw. Ztg., 45 (1896), No. 21, pp. 679–683*).

Sugar cane disease in British Guiana (*Kew Misc. Bul. No. 113–114, pp. 106–108*).—Notes are given of the presence of the rind disease due to *Trichosphæria sacchari* in the region indicated.

Root molds of sugar cane, J. H. WAKKER (*Med. Proefsta. East Java, n. ser., No. 28, pp. 9, pls. 2*).—Notes are given of *Cladosporium* (*Dematium*) *javanicum* n. sp., and *Allantospora radicicola*.

Studies on the diseases of wheat in 1895 in Sardinia, A. N. BERLESE (*Riv. pat. veg., 5 (1896), Nos. 1–4, pp. 88–97*).

Grain smuts and potato scab, A. NELSON (*Wyoming Sta. Rpt. 1895, Appen., pp. 5–24, figs. 4*).—A reprint of Bulletin 21 of the station (E. S. R., 6, p. 1000).

Asparagus rust, G. E. STONE (*Garden and Forest, 9 (1896), No. 452, p. 428*).—A brief note by the author mentioning the occurrence of this disease of asparagus at the Massachusetts Agricultural College.

Apple twig blight, F. C. SEARS (*Garden and Forest, 9 (1896), No. 456, pp. 467, 468*).—Notes are given of the variable resistance of different varieties of apples to attacks of the twig blight (*Micrococcus amylororus*).

A disease of the mulberry, A. N. BERLESE (*Riv. pat. veg., 5 (1896), Nos. 1–4, pp. 98–107*).

Melanose of the orange, H. J. WEBBER (*Florida Farmer and Fruit Grower, 7 (1896), p. 419*).

Peach yellows, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 393–408, figs. 7*).—A reprint of Bulletin 75 of the station (E. S. R., 6, p. 641).

Leaf curl and plum pockets, G. F. ATKINSON (*New York Cornell Sta. Rpt. 1894, Appen., pp. 319–355, pls. 20*).—A reprint of Bulletin 73 of the station (E. S. R., 6, p. 554).

Leaf blight of the strawberry, L. H. BAILEY (*New York Cornell Sta. Rpt. 1894, Appen., pp. 600–604, fig. 1*).—A reprint from Bulletin 79 of the station (E. S. R., 6, p. 910).

Black knot of plums and cherries and methods of treatment, E. G. LODEMAN (*New York Cornell Sta. Rpt. 1894, Appen., pp. 635–656, pls. 2, figs. 4*).—A reprint of Bulletin 81 of the station (E. S. R., 6, p. 908).

Experiments in controlling black rot, LAMBEL (*Prog. Agr. et Vit., 26 (1896), No. 43, pp. 469–474*).

Practical treatment for black rot, J. DUCOS (*Prog. Agr. et Vit., 26 (1896), No. 40, pp. 389–393*).—Bordeaux mixture and a powder of lime, sulphate of copper, and sulphur are recommended.

Prevention from black rot by coal smoke in Aveyron, J. DUCOS (*Prog. Agr. et Vit., 26 (1896), No. 44, pp. 493–496*).

Concerning the appearance of gum in grapevines and bacterial gummosis, E. RÁTHAY (*Jahresber. k. k. oenol. und pomol. Lehranstalt Klosterneuburg, 1896; abs. in Bot. Centbl., 68 (1896), No. 2, pp. 54–56*).

Some grape troubles of western New York, E. G. LODEMAN (*New York Cornell Sta. Rpt. 1894, Appen., pp. 413–454, figs. 6*).—A reprint of Bulletin 76 of the station (E. S. R., 6, p. 732).

Why, when, what, and how to spray, L. C. CORBETT (*West Virginia Sta. Bul. 43, pp. 229–244, figs. 6*).—This bulletin is a sort of spray calendar, in which the advantages of spraying are shown and directions given for application of various fungicides and insecticides. Specific directions are given for the prevention of attacks of fungi and insects upon the principal orchard and garden crops, and various forms of apparatus are described. Formulas for 20 fungicides and insecticides are also given.

Report of the bacteriologist, H. H. LAMSON (*New Hampshire Sta. Rpt. 1894, pp. 127–131*).—Reprinted from Bulletins 22 and 27 of the station (E. S. R., 7, pp. 140, 223.)

ENTOMOLOGY.

Two shade tree pests, C. M. WEED (*New Hampshire Sta. Bul. 33, pp. 9, figs. 4*).—This bulletin contains illustrated, descriptive, and remedial notes on the white-marked tussock moth (*Orgyia leucostigma*) and the sugar-maple borer (*Glycobius speciosus*). The tussock moth is seriously injurious to elm trees in early summer, only one annual brood

existing. It is advised that the egg masses of the moths be collected by hand during the winter and destroyed. The natural parasites will destroy many of the caterpillars that might hatch from eggs which are overlooked. The ravages of the caterpillars may be checked by spraying with Paris green.

The sugar-maple borer has done considerable damage in the central region of the State, producing holes as large as lead pencils in the bark of the trunks and rapidly causing the foliage to yellow and the trees to appear unhealthy. The beetles emerge in July and August, soon laying eggs that quickly hatch. The larvæ burrow obliquely upward through the bark in which they remain until spring, when they burrow into the wood, which they mine in all directions. The attacks of the insects seem to be confined to the sugar maple (*Acer saccharinum*). Indication of the borers is generally shown by the brownish sawdust-like casting thrown out of the hole, by means of which the larvæ can be located and may be dug out with a sharp knife during the hibernating season. Seriously injured trees should be cut down and burned before the larvæ mature.

The use of arsenites on tobacco, H. GARMAN (*Kentucky Sta. Bul. 63, pp. 68–80, pls. 2*).—The author has conducted a series of experiments on the effect of spraying tobacco with different preparations of Paris green. From 1 to 8 applications were given the different plats, beginning July 3. The amount of injury done by the worms to the plants in the different plats is tabulated. The quantity of liquid used and the amount of Paris green which each plant received are given.

The amount of arsenic acid found in a sample of tobacco from the different sprayings is shown in the following table, compiled from the averages of 2 separate determinations:

Arsenious oxid in dry tobacco.

Times sprayed.	Arsenious oxid.	Arsenious oxid in 1 lb.
	Per cent.	*Grains.*
1	Trace.	Trace.
2[1]	0.0139	0.973
2	Trace.	Trace.
3	.0002	.014
4	.0010	.070
5	.0034	.238
6	.0041	.287
7	.0069	.503
8	.0093	.651

[1] These plants were cut as soon as they were dry from the second spraying.

The question whether or not any danger to the consumer would accrue from the practice of using arsenites is still open to discussion, but it is thought that the small amount found even in the samples giving the largest content would not do any serious injury.

Numerous experiments were conducted to ascertain the proportion of Paris green necessary to be used.

Observations relative to the life history of the tobacco worm are given, in which it is shown that at the station there is evidence of 3 annual broods instead of 2, as hitherto believed. From the grower's standpoint the broods appearing one early in July and the other early in August are of the most consequence.

A summary by the author shows that it is not necessary to spray tobacco more than 3 times, provided the times of application are well chosen. Based upon his experience, the proper times of applying Paris green would be early in July, again early in August, with a third application about the middle of August. One part of Paris green to 160 gals. of water is of sufficient strength if properly applied, and under no circumstances is a strength greater than 1 part to 120 gals. advised.

Some good form of knapsack sprayer with an agitator is recommended for use where tobacco is grown on a sufficient scale. To those disliking the use of Paris green, a solution of cobalt placed in flowers of jimson weed is recommended.

Grasshoppers have been found to cause considerable damage to tobacco when other herbage becomes scarce in the latter part of summer, and it is recommended that all unnecessary growth which would harbor these pests should be kept down around the tobacco fields.

Foul brood, its natural history and rational treatment, W. R. HOWARD (*Chicago: G. W. York & Co., 1894, pp. 48, figs. 2*).

A fowl-infesting tick, C. FULLER (*Agl. Gaz. N. S. Wales, 7* (*1896*), *No. 9, pp. 590–597*).

Forms of the so-called potato scab caused by insects, A. D. HOPKINS (*West Virginia Sta. Special Bul. 2, pp. 97–111, figs. 11*).—Illustrated notes are given of *Epidapus scabies* and *Sciara* sp., which the author considers the cause of certain forms of potato scab. The usual methods for preventing the disease are recommended.

Leaf insects of sugar cane in Java, I, L. ZEHNTNER (*Med. Proefsta. East Java, n. ser., No. 27, pp. 12, pl. 1*).—Illustrated descriptions are given of 2 new leaf borers, *Hispella wakkeri* and *Eulophus femoralis*.

Plant lice on sugar cane, L. ZEHNTNER (*Med. Proefsta. East Java, n. ser., No. 29, pp. 14, pl. 1*).—Illustrated descriptive notes are given of *Aleurodes bergi*, a pest on sugar cane in Java.

Life histories and methods of combating cane borers, L. ZEHNTNER (*Med. Proefsta. East Java, n. ser., No. 25, pp. 20*).—Notes are given of *Schirpopoga intacta*, *Chilo infuscatellus*, and *Grapholitha schistaceana*.

Lawn and grass infesting insects, I, J. B. SMITH (*Garden and Forest, 9* (*1896*), *No. 456, pp. 463, 464, figs. 5*).—Illustrated notes are given of *Crambus vulvivagellus* and several click beetles and their larvæ.

On certain grass-eating insects; a synopsis of the species of Crambus of the Ithaca fauna, E. P. FELT (*New York Cornell Sta. Rpt. 1894, Appen., pp. 47–102, pls. 14, figs. 8*).—A reprint of Bulletin 64 of the station (E. S. R., 6, p. 62).

The cabbage root maggot, with notes on the onion maggot and allied insects, M. V. SLINGERLAND (*New York Cornell Sta. Rpt. 1894, Appen., pp. 481–577, figs. 18*).—A reprint of Bulletin 78 of the station (E. S. R., 6, p. 911).

The pear tree slug (Eriocampa cerasi), C. P. LOUNSBURY (*Agl. Jour. Cape Colony, 9* (*1896*), *No. 20, pp. 520, 521, figs. 5*).

A plum scale in western New York, M. V. SLINGERLAND (*New York Cornell Sta. Rpt. 1894, Appen., pp. 681–699, pl. 1, figs. 4*).—A reprint of Bulletin 83 of the station (E. S. R., 6, p. 1004).

Another plum scale, T. D. A. COCKERELL (*Garden and Forest, 9 (1896), No. 454, pp. 444*).—Notes are given of a new plum scale from Oregon. It is thought to be the European *Lecanium bituberculatum*, which attacks the hawthorn.

Insects of the year, J. TROOP (*Indiana Sta. Rpt. 1895, p. 20*).—This consists of a brief report of the insects especially injurious in Indiana in 1895, with mention of issuing of newspaper bulletins concerning the treatment of some of the species. The following species produced most damage: The apple tree plant louse (*Aphis mali*), several species of cutworms, especially the clay-backed cutworm (*Agrotis gladiaria*), the fruit bark beetle (*Scolytus rugulosus*), the Hessian fly (*Cecidomyia destructor*), the potato stalk borer (*Trichobaris trinotata*), and the chinch bug (*Blissus leucopterus*).

Attempts to inoculate chinch bugs with white fungus disease were not successful, owing to the dry atmospheric conditions.

The insect record for 1895, C. M. WEED (*New Hampshire Sta. Bul. 31, pp. 12–18, figs. 6*).—This lists the insects appearing especially injurious during the year, brief life history and remedial notes being given for the following species: Tent caterpillar, cankerworm, Colorado potato beetle, zebra caterpillar (*Ceranica picta*), rose chafer, oyster-shell bark louse, tomato worm (*Phlegethontius celeus*), striped cucumber beetle, squash bug, and sixteen-legged maple borer (*Ægeria acerni*).

Insect pests of the garden, farm, and orchard, C. V. PIPER (*Washington Sta. Bul. 17, pp. 66, figs. 64*).—Popular illustrated notes are given on the most common insect pests of the garden, farm, and orchard, together with suggestions for their destruction. Formulas for insecticides and illustrated descriptions of spraying apparatus are also given.

Italian scale insects infesting citrus fruits, A. BERLESE (*Riv. pat. veg., 5 (1896), Nos. 1–4, pp. 1–73, pls. 7*).

Some dangerous fruit insects, C. M. WEED (*New Hampshire Sta. Rpt. 1894, pp. 152–171, figs. 18*).—Reprint of Bulletin 23 of the station (E. S. R., 7, p. 143).

Notes on destroying red spider, W. TAYLOR (*Jour. Hort., n. ser., 1896, No. 854, pp. 440, 441*).—Notes are given of the use of gunpowder, sulphur, and carbolic acid.

Experiments with Rovarin in combating Cleomis punctiventris, F. ROVARA (*Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1896, p. 407; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 591, 592*).

Laurel, mustard, and kerosene as insecticides, G. ABBEY (*Jour. Hort., n. ser., 1896, No. 854, pp. 441*).

Petroleum as an insecticide, F. KRUGER (*Gartenflora, 1896, pp. 99–125; abs. in Bot. Centbl., 67 (1896), No. 12, pp. 375–377*).

Analysis of insecticides, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 121, 122*).—Analyses of 2 patented articles are reported.

FOODS—ANIMAL PRODUCTION.

The influence of the addition of fat and starch to a ration upon the digestibility of the nutrients of the food and upon the metabolism of nitrogen, A. WICKE and H. WEISKE (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 137–152*).

Synopsis.—In an experiment with sheep it was found that the addition of starch to the ration diminished the digestibility of protein and fat; the addition of fat did not affect the digestibility and resorption of protein and fat, but diminished that of nitrogen-free extract. Starch was found to be a better protector of protein than isodynamic quantities of fat.

The experiment, which is a continuation of work previously reported,[1] was made with 2 sheep weighing 52 kg. and 41 kg., respectively. The

[1] Ztschr. physiol. Chem., 21 (1895), p. 42 (E. S. R., 7, p. 336).

experiment was divided into 3 periods. The plan was to feed the basal ration of period 1 throughout the experiment, adding a moderate quantity of starch to the ration of sheep No. 1 in the second period and an isodynamic quantity of fat to the ration of sheep No. 2, and reversing these additions in the third period. It was found that sheep No. 2 could not eat as much as No. 1, so a somewhat smaller basal ration was fed, and owing to lack of time the third period was omitted with sheep No. 2. The basal ration of sheep No. 1 consisted of 800 gm. of meadow hay and 200 gm. of flaxseed from which the fat had been partially extracted by pressing, etc.; 174 gm. of starch was added in the second period and 60 gm. of olive oil in the third. The basal ration of sheep No. 2 consisted of 650 gm. of meadow hay and 200 gm. of the flaxseed, and 50 gm. of olive oil was added in the second period.

The food, urine, and feces were analyzed. Tables are given showing the amount and composition of the urine and feces, the amount and percentage of the nutrients digested, and the balance of income and outgo of nitrogen. The coëfficients of digestibility for each period for each sheep are shown in the following table:

Coëfficients of digestibility in experiments with sheep.

Ration.	Animal.	Dry matter.	Organic substance.	Protein.	Fat.	Crude fiber.	Nitrogen-free extract.	Ash.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Hay and flaxseed	No. 1	64.18	67.49	73.15	76.85	62.67	65.50	26.15
Do	No. 2	64.07	67.44	71.47	81.46	62.13	64.79	24.60
Hay, flaxseed, and olive oil	No. 1	63.44	66.53	71.58	87.78	62.10	58.77	25.10
Do	No. 2	64.67	67.76	72.02	86.45	65.66	59.81	25.63
Hay, flaxseed, and starch	No. 1	67.28	70.27	69.19	78.08	60.08	72.39	26.55

The conclusion is reached that the addition of starch to the ration diminished the digestibility of protein and fat, while the addition of fat did not affect the digestibility and absorption of protein and fat in these experiments, but diminished the digestibility of nitrogen-free extract.

The average amount of nitrogen consumed per day and excreted in the urine and feces and gain in nitrogen are shown in the following table:

Average daily nitrogen balance in experiments with sheep.

Ration.	Animal.	Nitrogen in— Food.	Urine.	Feces.	Gain.
		Grams.	Grams.	Grams.	Grams.
Hay and flaxseed	No. 1	22.04	15.16	5.92	0.96
Do	No. 2	19.39	13.11	5.53	.75
Hay, flaxseed, and olive oil	No. 1	22.04	14.75	6.27	1.02
Do	No. 2	19.39	12.58	5.43	1.38
Hay, flaxseed, and starch	No. 1	22.04	13.59	6.81	1.64

The conclusion was reached that when isodynamic quantities of starch and fat were added to a ration the starch was a better protector of protein than fat.

The author quotes at length from his previous experiments on this subject and states that further experiments are in progress.

The use of sugar in feeding animals, MALPEAUX (*Ann. Agron., 22 (1896), No. 6, pp. 281–296*).—The author gives a short review of the use of sugar in feeding animals. The experiment here reported was made by the author with 2 lots of young cattle, and was divided into 2 periods of 25 days each. Each lot consisted of 1 bull and 1 heifer. A basal ration consisting of 2 kg. of clover hay, 5 kg. of oat straw, 30 kg. of green corn fodder, 1 kg. of cotton-seed cake, and 1 kg. of mixed rye and horse-bean meal was fed per head daily. Two animals received in addition 500 gm. of brown sugar daily in the first period, and in the second period the other animals received the sugar. The animals were at pasture during the day. On the ration containing sugar the bulls gained 7 kg. more and the heifers 8 kg. more than on the same ration without sugar. The bulls sold for 13 cts. and the heifers 14 cts. per kilogram, live weight. The sugar fed was worth $3\frac{1}{5}$ cts. per kilogram. The author concludes that the feeding of sugar gave a total profit of 11 cts. in the case of the bulls and 32 cts. in the case of the heifers.

A second experiment, with practically the same ration and of the same duration, was made with 4 milch cows. During the period when sugar was fed with the ration the cows gained somewhat more in weight than when no sugar was fed. Neither the yield nor composition of the milk was materially affected by the addition of sugar.

Definite conclusions were not drawn, but the author believes that in a general way sugar tends to increase the production of meat and fat.

On the comparative digestibility of whole oats, rolled oats, and crushed oats, P. GAY (*Ann. Agron., 22 (1896), Nos. 4, pp. 145–160; 5, pp. 225–244*).—The first experiment reported was made with a sheep, and was divided into 3 periods. During the first period, from June 6 to 20, 500 gm. of whole oats and 750 gm. of lucern hay were fed daily; during the second period, from June 20 to July 4, the same amount of rolled (*apatie*) oats and hay were fed; and during the third period, from July 4 to 18, the same amount of crushed (*concassee*) oats and hay. The animal weighed at the beginning of the first period 80.7 kg., and at the end of the period 80.2 kg.; at the end of the second period it weighed 79.5 kg.; and at the end of the third period, 80 kg. The experiment is discussed at length and the results given in detail in tabular form.

The coëfficients of digestibility of the rations for the 3 periods are given in the following table:

Coëfficients of digestibility in experiment with a sheep.

	Total.	Protein.	Ether extract.	Nitrogen-free extract.	Cellulose.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Period 1 (whole oats and hay)	66.24	73.03	58.31	75.10	45.55	36.68
Period 2 (rolled oats and hay)	66.60	74.62	64.81	78.55	45.03	26.55
Period 3 (crushed oats and hay)	67.03	73.59	72.20	76.99	44.75	27.14

The author concludes that it is useless to grind grains which are fed to sheep. He believes that the results which he has obtained with oats can be applied to other grains, but suggests that grinding grains would prove of advantage in feeding cattle.

The second experiment, which was made with a horse, was divided into 3 periods, the first extending from November 22 to December 5, 1895, the second from December 5 to 19, and the third from December 19 to January 1, 1896. During the first period the horse received a daily ration of 3 kg. of whole oats and 2 kg. of meadow hay, during the second period the same quantities of rolled oats and hay, and during the third period the same quantities of crushed oats and hay. During a preliminary period of 6 days the animal was fed 3 kg. of entire oats and 2 kg. of cut hay daily. At the beginning of the first period he weighed 333 kg., and at the end of this period his weight was the same; at the end of the second period he weighed 342 kg., and at the end of the third period, 350 kg.

The experiment is discussed at length, and details are given in tabular form. The coëfficients of digestibility of the 3 rations are shown in the following table:

Coëfficients of digestibility in experiment with a horse.

	Total.	Protein.	Ether extract.	Nitrogen-free extract.	Cellulose.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Period 1 (whole oats and hay)	64.53	71.30	40.90	74.70	42.00	27.78
Period 2 (rolled oats and hay)	68.58	79.15	59.46	74.99	48.87	31.97
Period 3 (crushed oats and hay)	72.73	94.11	54.78	75.19	63.60	42.71

The rolled and crushed oats were found to be more digestible than the whole oats, 92 kg. of crushed oats and 96 kg. of rolled oats having the same feeding value as 100 kg. of entire oats. The cost of milling, however, must be taken into account. Ringelmann's work on this subject is quoted at length.

Experiments in swine feeding, W. A. HENRY (*Wisconsin Sta. Rpt. 1894, pp. 5–27*).

Food required during growth by full-blood Poland-China and Berkshire pigs (pp. 5–8).—Three tests were made with Poland-China and Berkshire pigs, 1 boar and 4 sows of each breed. The test began August 18 and continued 224 days. It was divided into 3 periods of 154, 35, and 35 days.

During the whole test the pigs were fed a grain ration, consisting of wheat shorts and corn meal in equal parts, separator skim milk, and whey. During period 2, 2 sows from each breed received half a pound of cotton-seed meal daily, and the 2 remaining sows and the boar received the same amount of linseed meal. During period 3 these foods were reversed. The sows had the run of a short blue-grass pasture until winter. They were then confined in a roomy pen and separated only at the time of feeding.

The results are expressed in tabular form. During the whole test the 5 Poland-Chinas gained 1,168 lbs. and the 5 Berkshires 1,167 lbs. The amount of each sort of food required for 100 lbs. of gain by the 2 breeds is shown in the following table:

Food required for 100 lbs. gain in live weight.

	Poland-Chinas (1 boar, 4 sows).	Berkshires (1 boar, 4 sows).
	Pounds.	*Pounds.*
Grain (wheat shorts and corn meal)	340	327
Cotton-seed meal and linseed meal	15	15
Skim milk	558	560
Whey	589	584

Practically the same gains were made by each lot. This fact is further shown in discussing the results by substituting for skim milk and whey a calculated equivalent amount of grain.

Cotton-seed meal and linseed meal as a partial grain food for pigs (pp. 9–11).—The 2 periods in the above experiments during which cotton-seed meal was fed are discussed in detail. A table is given showing the amount of food consumed by each lot, the average weight at the beginning, and the gain in weight.

"Giving to whey and milk their grain equivalent as used in the previous trial, we find that for 100 lbs. of gain, live weight, it required 492 lbs. of meal or its equivalent, with the pigs getting cotton-seed meal, and 516 lbs. of meal or its equivalent, with the pigs getting linseed meal. Our pigs receiving linseed meal therefore ate 24 lbs., or 5 per cent, more of feed than did those getting cotton-seed meal. . . .

No deleterious effects were noticed with our pigs, but it should be remembered that the experiment lasted only 7 weeks and that the quantity of cotton-seed meal fed was very small. It is probable that cotton-seed meal can be fed to pigs successfully as in our case where the quantity of meal so given is small, not over one-quarter of a pound daily for each hundredweight of animal."

The relative value of cooked and uncooked feed for swine (pp. 11–20).—This work is a continuation of that given in the Annual Report of the station for 1886. It includes a brief summary of the work done at the station and elsewhere on this subject. The results are given of 5 tests, in each of which one lot was fed corn meal which had been cooked into a thick mush, another lot corn meal which had been moistened with hot water and fed at the same temperature as the mush (100°). In 3 tests a third lot was fed a ration of equal parts of cooked and uncooked corn meal. The first test was made with 15 full blood and 6 grade Berkshire pigs, divided into 3 lots of 7 each; the second test was made with 12 Berkshire pigs, divided into 3 lots of 4 each; the third with 6 crossbred Berkshire-Yorkshire pigs, divided into 3 lots of 2 each; the fourth with 4 Poland-Chinas and 16 Berkshires, divided into 2 lots of 10 each; and the fifth with 2 crossbred Poland-China-Berkshires and 6 Poland-Chinas, divided into 2 lots of 4 each. In each case a preliminary period of 1 week preceded the test.

Detailed results for each pig for each test are given in tabular form, including weight at beginning, gains in weight, and food consumed. The average amount of cooked food consumed per 100 lbs. of gain during the 5 trials was 439 lbs. and of uncooked food 454 lbs.; and the average amount of mixed food (cooked and uncooked) consumed during the 3 trials was 448 lbs.

"As a result of these trials we may say that under the most favorable conditions we have been able to secure and with the greatest care in the preparation of the cooked feed we were enabled to make a saving of 3.4 lbs. of meal for each 100 required when feeding cooked and uncooked meal to swine. With the number of pigs fed on an ordinary farm it would not be profitable to attempt such a saving; in very large establishments it might pay."

Wheat as a food for fattening hogs (pp. 20–23).—Three tests were made with Berkshire pigs to compare the relative value of wheat meal, corn meal, and a mixture of both. Tests 1 and 2, which were made with 2 lots of 3 pigs each, were divided into 2 periods of 5 weeks. In each case lot 1 was fed wheat meal and lot 2 half wheat meal and half corn meal. In each case the meal was made into a slop with water. Test 3, which was made with 3 lots of 3 pigs each, was divided into 3 periods of 3 weeks. Lots 1 and 2 were fed as in the previous test, and lot 3 was fed corn meal alone. Each test was preceded by a preliminary period of 6 days on the feed used in the test proper.

Detailed results for each test are given in tabular form, including weight at beginning, gain in weight, and food consumed. The average amount of wheat consumed per 100 lbs. of gain in the 3 trials was 512 lbs., wheat meal and corn meal (1:1) 493 lbs., and corn meal 499 lbs.

The following conclusions are drawn:

"In the third trial the mixture of wheat meal and corn meal was more effective than either wheat meal or corn meal when these two were fed separately.

"These trials are too few in number to warrant any general conclusions."

The value of pigeon-grass seed for swine feeding (pp. 23–27).—Pigeon grass is a common weed in the Northwest. Its seed is often found in wheat and is separated at the mills and elevators, where it accumulates in large quantities. That used in these tests cost $4 per ton.

Two tests of 5 weeks' duration were made with 3 lots of 3 pigs each. Those used in the first test were Poland-Chinas, and those in the second Berkshires. In each test lot 1 was fed a ration of ⅓ ground pigeon-grass seed and ⅔ corn meal uncooked; lot 2 a ration of ⅔ cooked pigeon-grass seed and ⅓ uncooked corn meal; and lot 3 uncooked corn meal. The pigs were fed all they would eat up clean. The pigeon-grass seed was stirred into boiling water and cooked for about 15 minutes and a little salt was added. The pigs ranged in weight from 218 to 258 lbs. at the beginning of the trials.

Detailed results for each test are given in tabular form, including weight at beginning, gains in weight, and food consumed. The average amount of corn meal consumed per 100 lbs. of gain in the 2 trials

was 535 lbs.; uncooked pigeon-grass seed and corn meal, 566 lbs.; and cooked pigeon-grass seed and corn meal, 522 lbs.

In each trial the lot on cooked pigeon-grass seed and corn meal made considerably the largest gains, followed by the lot on corn meal alone.

The following conclusions are drawn:

"The hogs which consumed the most food gave the best returns for the food consumed.

"From our preliminary investigations and these trials we conclude that hogs will not take kindly to a feed where more than one-third of it consists of pigeon-grass seed meal, and that with a ration of one-third pigeon-grass seed meal and two-thirds corn meal somewhat more feed is required for a given gain than with corn meal alone. When, however, the pigeon-grass seed meal is cooked, as much as two-thirds of the ration may consist of this material, and that when two-thirds of the ration is cooked pigeon-grass seed meal and the other third corn meal a gain may be produced with less pounds of the mixture than on corn meal alone.

"By comparing the results of these trials with those where wheat meal was fed to pigs it will be found that our pigeon-grass seed meal compares very favorably with that highly prized food article."

Rape for feeding sheep, J. A. CRAIG (*Wisconsin Sta. Rpt. 1894, pp. 28-41, pls. 3, figs. 2*).—The author discusses the culture and harvesting of rape. Three tests were made with rape for fattening lambs. The first, which lasted from October 13, 1893, to November 7, was made with 16 wethers. Eight had been shorn and the remainder were unshorn. They were hurdled on $\frac{7}{10}$ of an acre of rape. For the first week the lambs were fed $\frac{1}{2}$ lb. of oats per head daily, and for the rest of the period the grain ration consisted of $\frac{1}{2}$ lb. of a mixture of corn and oats, 1:1.

The total weight of the lot at the beginning of the test was 1,260 lbs. and at the end 1,409 lbs., a weekly gain per head of 2.6 lbs. The lambs cost $3\frac{1}{2}$ cts. per pound and sold for 4 cts. per pound at the end of the test. Valuing the oats at $18 and the corn at $15 per ton, the $\frac{7}{10}$ acre of rape was worth $10.14, or at the rate of $14.48 per acre.

The second test, which began August 15, 1894, and lasted 10 weeks, was made with 22 wethers. One died shortly after the beginning of the experiment. The lambs were turned into $\frac{1}{2}$ acre of rape, which had been sown June 18 at the rate of 3 lbs. per acre in drills 30 in. apart, and had received 2 cultivations. In addition they were given daily an hour's feeding on ordinary blue-grass pasture. For the first 4 weeks they were fed a ration of ground wheat. For the next 5 weeks they were given a ration of 2 parts ground wheat and 1 part oats, and for the remainder of the test a ration of equal parts by weight of oats, wheat, and linseed meal. The amount of grain fed per head daily was about $\frac{1}{2}$ lb. at the beginning and $1\frac{1}{2}$ lbs. at the end of the test.

At the beginning of the test the lot weighed 1,622 lbs. and at the end $2,035\frac{1}{2}$ lbs., or a gain of nearly 2 lbs. per head a week. Valuing the lambs at 3 cts. a pound at the beginning of the test and $3\frac{1}{2}$ cts. a pound at the end of the test, and considering wheat worth $16.60, oats

$18, and linseed meal $25 per ton, the rape was worth $10.12 for the half acre, or $20.24 per acre.

The third test was made with the lambs used in the second. They were put on $\frac{1}{10}$ acre of rape, which had been sown July 6 at the rate of 4 lbs. per acre, but owing to an exceptionally dry season had not made a good growth. The test lasted from October 24 to November 7. In addition to the rape the sheep had the run of a pasture a short time each day and received per head daily 1.6 lbs. of grain consisting of equal parts of ground wheat, oats, and linseed meal.

The weight of the lot at the beginning of the test was 2,035½ lbs. and at the end 2,177½ lbs., or a weekly gain per head of 3.3 lbs. In the author's opinion "this high rate of gain was undoubtedly largely contributed to by the heavy grain feeding, the pasture they received, and in some degree to their previous management."

It is pointed out that in feeding rape there is danger from bloating and diarrhea, as the sheep eat too much of the rape at first, and the author advises that at first the sheep be allowed to eat the rape only a short time each day.

Breeding early lambs, J. A. CRAIG (*Wisconsin Sta. Rpt. 1894, pp. 42–52, figs. 5, pls. 2*).—In the first week of June, 1891, experiments were undertaken with 26 Shropshire ewes to test several methods of inducing breeding ewes to take the ram earlier than the customary time, as follows: For 5 days they were kept on dry hay, followed by 4 weeks' feeding on green clover *ad libitum*. In July they were fed oat straw for 2 weeks, followed by 2 weeks on green clover; for a week they were driven each day on the road; and they were kept for 2 weeks in a building where the temperature was maintained at 55° F. All these methods were unsuccessful.

Nine grade Shropshire ewes, previously shown to be good breeders and the result of about 10 years' breeding on a Merino foundation with Shropshire rams, were bred to an imported Dorset ram, weighing 268 lbs. at 4 years 9 months. Of the ewes, 9 averaged 116 lbs. in weight; 3, 156 lbs.; and 2, 184 lbs. They had full mouths. The 9 ewes produced 1 set of triplets, 6 of twins, and 2 singles, 17 in all.

The author says that in these lambs the influence of the ram is most prominent. The 9 ewe lambs were kept for breeding and weighed on the average as shearlings 153 lbs., and 7 at 2 years averaged 185.5 lbs. June 16, 1893, at 1 year and 4 months old, these ewes, with their sire, were together put in a small pasture. By July 9 all had been bred once; later 3 were served a second time; and 3 failing to become pregnant were served in the fall. By December 21, 5 ewes had dropped 7 lambs, of which 2 died. The author states that "these lambs show the Dorset traits very strongly, as would be expected from the fact that they are second cross Dorsets. . . .

"The chief point of the experiment up to this time lies in the fact that the characteristics of the Dorset to breed fully 3 months earlier

than other breeds is transmissible through the male line to the first cross. This suggests an economical and commendable method of establishing a flock for breeding early lambs."

Fall shearing lambs before fattening, J. A. CRAIG (*Wisconsin Sta. Rpt. 1894, pp. 53–59*).—This is a continuation of work given in the Annual Reports of the station for 1891 and 1892 (E. S. R., 4, p. 184; 5, p. 504). The article contains references to previous work, and reports 2 new experiments—one made in 1892 and one in 1893. In the 1892 test 10 grade Shropshire wethers were divided into 2 lots. The conditions of feeding were the same for both lots, one lot being shorn October 14 and the other lot was left unshorn. In the 1893 test 16 Shropshire wethers were divided into 2 lots. The conditions of feeding were the same for both lots. Lot 1 was shorn October 6 and lot 2 left unshorn.

From these experiments and those previously reported the following conclusions were drawn:

"(1) Fall shearing is a beneficial practice to prepare lambs that are 6 months old for the early winter market.

"(2) To secure the benefits of fall shearing it should be done early in the season, at least not later than October.

"(3) When done under such circumstances the removal of the fleece hastens the fattening, and the gain is made at a slightly cheaper rate.

"(4) The results show that by shearing in the fall and again in the spring more wool is obtained than from a single spring shearing, but the market value of the 2 clippings is not any greater than that of the single clipping in which the fibers of the fleece are longer.

"(5) When the lambs are to be fattened during three or four of the winter months, there appears to be no practical advantage in fall shearing."

Breeding experiments, E. C. CHILCOTT (*South Dakota Sta. Rpt. 1894, pp. 17, 18*).—Experiments have been undertaken to test the value of the Horned Dorset to cross on grade Shropshire ewes from a Merino foundation. The records kept at the station include the effect on the weight of fleece, size of carcass, and time required for maturity.

The offspring of Duroc Jersey sows and Poland-China boars have proved equal to if not superior to pure-bred animals for pork, and the cross-bred sows have given good results as breeders.

Food and diet, W. O. ATWATER (*U. S. Dept. Agr., Office of Experiment Stations, Charts I–IV, size 26 by 40 in.*).—These include the following 4 colored charts:

Chart I. Nutrients of Food and Their Uses in the Body. This shows in tabular form the composition of food materials as purchased, with examples of the different nutrients and functions of each. The definition of food is also given.

Chart II. Composition of Food Materials. This shows by means of colored lines the percentage composition and fuel value of a number of common food materials, both animal and vegetable.

Chart III. Pecuniary Economy of Food. This gives the amount of a number of food materials which may be purchased for 10 cts., and shows by means of colored lines the percentage composition and fuel value of each.

Chart IV. Dietaries and Dietary Standards. This shows by means of colored lines the nutrients and fuel value of the dietaries consumed by people of various conditions in the United States and other countries. The dietary standards for man at little work, at moderate work, and at severe work are also given.

Food and water supply of the native tribes of Australia, R. HELMS (*Trans. Roy. Soc. of South Australia, 16, pt. 3, pp. 253–259*).—In an extended article on the native Australian tribes entitled "Anthropology" the foods and food supply, methods of preparing foods, etc., are discussed at length.

Analyses of American "dry pickled meat," C. AMTHOR (*Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), p. 212; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, p. 163*).

On the use of a new casein preparation, "Eucasin," as food, E. SALKOWSKI (*Deut. med. Wochenschr., 22 (1896), p. 225; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, p. 165*).—"Eucasin" is a white powder, soluble in warm water, obtained by passing ammonia over casein. In the author's opinion it is preferable to "somatose" for nutritive purposes.

Edelweiss-Camembert cheese, analysis and digestion experiments, A. STUTZER (*Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, p. 182*).—Edelweiss-Camembert is compared with Swiss and Gervais cheese. Artificial digestion experiments were made.

Special report on prepared foods for invalids and infants, F. N. MOORE (*Pennsylvania Dept. Agr. Bul. 10, pp. 11*).—This includes analyses of a number of evaporated creams and unsweetened condensed milks, liquid foods, and peptonoids and prepared foods for infants and invalids. The various preparations are discussed at some length.

The chemical composition of a number of infant foods, together with a brief account of analytical methods and the present standpoint regarding artificial foods for children, M. BLAUBERG (*Arch. Hyg., 27 (1896), No. 2, pp. 105–175*).—The article contains analyses of 17 infant foods. The nutrients were determined and also the mineral constituents.

The advantages and disadvantages of the use of sterilized milk for infant feeding, H. J. CAMPBELL (*Brit. Med. Jour., 1896, No. 1863, p. 623–626; Diet. and Hyg. Gaz., 12 (1896), No. 10, pp. 650–655*).—The author recommends pasteurized in preference to sterilized milk.

Fruit as food, A. R. ELLIOT (*Diet. and Hyg. Gaz., 12 (1896), No. 11, pp. 663–665*).

The poisonous properties of sulphurous acid and salts and their use in articles of diet, KIONKA (*Ztschr. Hyg. und Infektionskr., 22 (1896), No. 3; abs. in Ztschr. Fleisch. Milch. Hyg., 7 (1896), No. 1, pp. 11, 12*).—The author fed dogs meat preserved with sulphites, and found that when the dose was large the dogs suffered from diarrhea and other disturbances. When the dose was small but long continued, bad results were also observed. The author therefore recommends that the use of such salts as preservatives be forbidden.

The phosphoric acid of barley and malt, A. FERNBACH (*La Bière et les Boissons fermentées, 4, p. 81; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, pp. 243, 244*).

Whole bread, LAUMONIER (*Bul. gén. de Thérap., 130 (1896), p. 319; Chem. Ztg., 1896, p. 143; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, p. 261*).—According to the author, when properly prepared the bread contains more nitrogen, fat, ash, and phosphates than ordinary white (Paris) bread.

Foods; their composition and analysis, A. W. BLYTH (*London: C. Griffin & Co., 1896, 4th ed., pp. 768*).

Chart showing the anatomical structure of vegetable foods and condiments, F. ROSEN (*Anatomische Wandtafeln der vegetabilischen Nahrungs- und Genussmittel; Breslau, 1896, Pt. II*).—Five charts showing the structure of mustard, coffee, and several coffee surrogates.

Diet for school boys (*The Hospital, 20 (1896), Nos. 513, p. 275; 514, p. 59; Diet. and Hyg. Gaz., 12 (1896), No. 10, pp. 616–618*).

How to live well on 25 cents a day, MRS. G. LEMCKE (*New York: J. D. Ogilvie Pub. Co., 1896, pp. 170*).—Daily menus for 6 weeks, with directions for preparation, are given, and much advice on preparing a wholesome and nutritious diet at a moderate cost.

Munk and Uffelmann's nutrition of man in health and disease, I. MUNK and C. A. EWALD (*Munk und Uffelmann's Ernährung des gesunden und kranken Menschen. Vienna und Leipsic: Urban und Schwarzenberg, 1895, 3d ed., pp. 8, 591*).

Diet in sickness and health, Mrs. E. HART (*London: The Scientific Press, 1896, pp. 219, figs. 17*).—A clear and careful summary of the subject, with practical application. The introduction is by Sir Henry Thompson. Foods and food values, alcohol, cocoa, tea, coffee, chocolate, and similar products are discussed at length, and diets and dietaries suited to different conditions and practical directions for preparing many of the foods suited to various forms of disease are given.

Analyses of some substances sold as cream of tartar, G. F. PAYNE (*Georgia Dept. Agr. Bul. 32, pp. 24–28*).—This article is reprinted from the *Druggists' Circular.* The author reports analyses of 11 substances sold as cream of tartar. Out of 10 samples purchased 5 contained absolutely no cream of tartar, 2 contained less than 57 per cent, and 1 less than 80 per cent.

The economic value of cotton-seed hulls as a feeding stuff, G. F. PAYNE (*Georgia Dept. Agr. Bul. 32, pp. 36–38*).—This is an address delivered before the Georgia State Agricultural Society at its meeting at Augusta, Georgia, February 15, 1893, briefly summing up the subject.

Analyses of feeding stuffs, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 118–120*).—Tabulated analyses of Nutriotone, gluten meal, gluten feed, Thorley food, oat feed, corn silage, apple pomace, and oat-straw silage and apple pomace.

Microscopical examination of concentrated feeding stuffs (*Sächs. landw. Ztschr., 1896, No. 20, pp. 226, 227*).—Statistics of Pomeranian analyses.

Feeding experiment with fresh grapevine leaves, J. SAMEK (*Tirol. landw. Blätter, 15 (1896), No. 13, p. 118*).—A cow with a calf 1 week old was fed 16 to 48 kg. of fresh grapevine leaves per day for 9 days. No bad effects on the cow or calf were observed.

Principles of stock feeding and some New Mexico feeding stuffs, A. GOSS (*New Mexico Sta. Bul. 17, pp. 23–54*).—The author discusses the use and composition of foods, and comparison and valuation of feeding stuffs, quoting the results of a number of investigators. The average composition and digestibility of a number of American feeding stuffs are quoted, and the composition and the computed digestible nutrients of some New Mexico feeding stuffs are also given. These include prickly pear, sotol, alfalfa, corn stover, millo maize stover, white Kafir corn stover, pearl millet stover, tornillo beans, mesquite beans, ordinary gramma grass, black gramma grass, 6 weeks' gramma grass, tall gramma grass, bunch grass, barnyard grass, vine mesquite grass, salt grass, corn, millo maize, white Kafir corn, red Kafir corn, Egyptian corn, pearl millet, German or golden millet, and wheat bran. A detailed description of some of the lesser known feeding stuffs is given. Feeding standards are quoted and methods of compounding rations explained.

The control of feeding stuffs in 1895, F. BARNSTEIN (*Sächs. landw. Ztschr., 1896, No. 37, pp. 447–449*).

Farm foods, or the rational feeding of farm animals, H. H. COUSINS (*Translated from E. von Wolff's Landwirtschaftliche Futterungslehre. London: Gurney & Jackson, 1895, 6th ed., pp. XVI, 365*).

Protein metabolism when antipeptone is consumed, C. VOIT (*Sitzungsber. beyer Acad. Wissensch., 25 (1896), No. 3, pp. 443–446; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 11 (1896), No. 2, p. 165*).—Feeding experiments showed that while albumose could replace protein, antipeptone could only act as a protector of protein. The author believes that this does away with the theory that protein must be changed to peptone before it is absorbed in digestion. Antipeptone must be regarded as a more complete cleavage product of protein.

Uric acid and diet, A. HAIG (*Brit. Med. Jour., 1896, No. 1866, pp. 915–917, dgms. 5*).—The author shows the effect of diet on the uric acid content of the urine and discusses uric acid in its relation to disease.

Pathology of metabolism; a text-book for physicians and students, C. VON NOORDEN (*Lehrbuch der Pathologie des Stoffwechsels für Aerzte und Studirende. Berlin: August Hirschwald, 1893, pp. XIII, 492*).—The book includes extended chapters on normal metabolism and metabolism in fever, diseases of the digestive and circulatory systems, diseases of the kidneys, and other pathological conditions. Bibliographies are given at the end of each chapter, and summaries of the results which have been obtained by various investigators.

Communicability to man of diseases from animals used as food, H. BEHREND (*Jewish Chron.; Diet. and Hyg. Gaz., 12 (1896), No. 10, pp. 611–614*).—This is a popular article showing that disease can be communicated to man from animals and insisting on the need of inspection.

Tuberculous infection from food, C. E. WINSLOW (*Jour. Amer. Med. Assn.; reported in Diet. and Hyg. Gaz., 12 (1896), No. 10, pp. 621–624*).—In a lecture the author points out the danger of infection from milk, meat, and other articles, and insists on the need of inspection.

Poisoning by potatoes (*Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), No. 17, p. 296*).—Three hundred and fifty-seven soldiers in a battalion of the Austrian army showed symptoms of solanin poisoning. The potatoes used for food were examined. Fresh potatoes contained 0.04 to 0.046 per cent solanin, while sprouted potatoes contained 0.08 to 0.116; those with sprouts 4 cm. long, 0.212 per cent. The sprouts themselves contained much more. Old potatoes (1 year) or those which have laid in a cellar and shriveled and small potatoes which were air-sprouted were considered to be particularly poisonous. Such should not be eaten.

Relative efficiency of animals as machines, M. MILES (*Amer. Nat., 30 (1896), No. 358, pp. 784–795*).—A paper read at the Buffalo meeting of the American Association for the Advancement of Science. The author does not think it sufficient to formulate diets and nutritive ratios in terms of the chemical constituents of foods.

Feeding wheat to hogs, E. C. CHILCOTT (*South Dakota Sta. Rpt. 1894, Bulletins, pp. 16, pls. 5*).—Bulletin 38 of the station (E. S. R., 6, p. 161), bound with the Annual Report.

Grain feeding lambs for market, J. A. CRAIG (*Wisconsin Sta. Rpt. 1894, pp. 60–85, pls. 2, dgm. 1*).—This is a reprint of Bulletin 41 of the station (E. S. R., 6, p. 661).

California Angora goats (*Amer. Cultivator, 58 (1896), No. 42, p. 1*).—A popular article with some shearing statistics.

Annual reports of the live stock associations of the province of Ontario, 1895–'96 (*Ontario Dept. Agr., pp. 166, figs. 10*).

Practical poultry feeding, Mrs. L. RAWSON (*Dept. Agr. Brisbane, Bul. 8, 2d ser., pp. 44, figs. 2*).—This bulletin discusses at length poultry houses, feeding, care, diseases, food value of eggs, caponizing, and incubators. Attention is given to ducks, turkeys, geese, and guinea fowl as well as chickens.

Red saddled Yokohamas (*Deut. landw. Presse, 23 (1896), p. 727, pl. 1*).—A description is given of this breed of poultry.

Annual reports of the poultry and pet stock association of the province of Ontario, 1895 (*Ontario Dept. Agr., pp. 63, figs. 7*).

VETERINARY SCIENCE AND PRACTICE.

On the efficiency of tuberculin as a diagnostic agent in tuberculosis, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1894, pp. 166–195, figs. 4*).—In this article are reported tests made with tuberculin upon 4 herds and some isolated cases. The tabulated data show the temperatures before and after injection, and autopsy records are given of 28 animals in the station herd.

In the test of the station herd tuberculin from this Department and from Berlin was used, but the quantity of the latter was too small to permit a fair comparison. In the first inoculation of the station herd, 22 of the 30 animals treated responded to the test.

"Nine were inoculated with Department tuberculin, of which 6 showed reaction temperatures. Of the 21 inoculated with imported tuberculin, 10 were mature and 11 were young stock. Of the 10, 7 were diagnosed as diseased; and of the young animals, 9 out of the 11 showed a diseased condition by the test."

After about 7 weeks a second test was made with the full grown animals, using in all cases a different kind of tuberculin from that which was first employed.

"In this second test of the 9 animals that were inoculated with imported tuberculin only 2 showed a reaction fever, while of the 9 treated with Department tuberculin 7 were diagnosed as diseased. . . .

"In two instances reaction temperatures were noted upon the second injection after they were declared healthy by the first. As the lapse of time between the two inoculations in these cases was 7 weeks, it is possible that they might have contracted the disease during this interim, especially as they were kept under the same conditions as before with a herd two-thirds of which were known to be tuberculous."

It was noted that in several instances animals failed to react with a light dose of tuberculin that had reacted upon the first injection with a full dose 7 weeks previous. In every one of the 25 animals diagnosed as diseased tuberculous lesions were present, and in one instance a tuberculous condition was found in an animal that had given no reaction.

The results of the tests of all herds are summarized in the following table:

Summary of results of tuberculin tests.

Herd.	Number of animals tested in each herd.	Number diagnosed by test as diseased.	Number found diseased at autopsy.	Failures in diagnosis.
I	30	25	26	1
II	20	4		
III	23	1	1	0
IV	12	0		
V[1]	8	0		
	93	30	27	1

[1] Isolated cases are included under Herd V.

In conclusion, the author states that the tuberculin test has failed in only 1 case. Out of the 30 animals condemned by the test only 7 had been recognized as tuberculous by the physical examination; and it has detected nearly 5 times the number of cases discoverable by the ordinary method. A full set of anteinoculation temperature readings is considered necessary to make a correct diagnosis more certain.

Additional report upon tuberculin tests, H. H. LAMSON (*New Hampshire Sta. Bul. 31, pp. 19–24*).—Notes and tabulated data upon

tuberculin tests upon the station herd. Ten head of young cattle were tested for the first time, and 19 other cattle, 6 of which had been in quarantine. Three of the cattle were condemned as being tuberculous, while the others were decided to be free from the disease. The tables show the temperature records of the test.

The infectiousness of milk from tuberculous cows, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1894, pp. 196–200*).—The author states that while some experimenters believe that the tubercle bacilli are only present in the milk where there is a demonstrable lesion in the udder caused by the disease, others hold that tuberculous animals produce infectious milk, even though the disease may not be present in the lacteal organs.

Rabbits and guinea pigs were inoculated with milk from a number of tuberculous cows in the station herd, using the fresh milk or the sediment in the bottom of sterilized Erlenmeyer flasks in which the milk had been treated centrifugally. The results are tabulated. The experimental animals were infected by the milk of one animal only. Her udder was badly swollen, and a microscopic examination revealed the presence of numerous tubercle bacilli in it.

The author's conclusions are as follows:

"From these limited experiments the conclusion in this case seems warranted that the milk from these tuberculous animals was not infectious where the disease was not localized in the udder. Even where the udder was possibly affected the bacilli were not present in the milk in sufficient quantities to call forth a diseased condition in the susceptible animal inoculated with small quantities (1 to 4 cc.), except in a single instance, where the animal had the disease in an aggravated form. These results add somewhat to the data on this subject, but the amount of evidence must be considerably augmented before definite conclusions are drawn as to the infectiousness of milk from tuberculous animals where the disease does not affect the udder."

Relation of separator slime to tuberculosis in hogs, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1894, pp. 201–204*).—The author mentions the observations of some German writers to the effect that in Germany and Denmark the percentage of tuberculous hogs is much greater where the cream is raised by separator than where it is raised by gravity.

August 23 four 6-weeks-old pigs from the same litter were divided into 2 lots and fed on skim milk and grain—equal parts of shorts and corn meal. One lot received in addition the separator slime from the University creamery, amounting to 7 or 8 lbs. a week, or 5.4 per cent of the whole amount of food consumed. The test ended November 10 and the pigs were killed November 13. The autopsies showed no signs of tuberculosis.

According to the author the experiment shows that the separator slime when fed in the proportions stated did not have infectious properties when introduced into the digestive tract of the animal.

Check list of the animal parasites of chickens, A. HASSALL (*U. S. Dept. Agr., Bureau of Animal Industry Circular 9, pp. 7*).—This list is intended to contain all of

the animal parasites of the barnyard fowl recorded up to the present time. Sixty-seven species are listed, classified under Protozoa, Trematodes, Cestodes, Nematodes, Arachnids, and Insects. A synonomy of the different species is given, and in addition the habitat in the host.

Check list of the animal parasites of turkeys, A. HASSALL (*U. S. Dept. Agr., Bureau of Animal Industry Circular 12, pp. 3*).—This consists of a list of 14 species and their synonyms, classified under Protozoa, Trematoda, Cestoda, Nematoda, Arachnida, and Insecta.

Concerning the recognition of splenic fever in the blood and animal tissues by microscopical examination, G. MARPMANN (*Ztschr. angew. Mikros., 2 (1896), No. 7, pp. 193–196*).

Tuberculosis in relation to animal industry and public health, J. LAW (*New York Cornell Sta. Rpt. 1894, Appen., pp. 105–157*).—A reprint of Bulletin 65 of the station (E. S. R., 6, p. 77).

Experiments with tuberculin on non-tuberculous cows, J. LAW (*New York Cornell Sta. Rpt. 1894, Appen., pp. 659–676*).—A reprint of Bulletin 82 of the station (E. S. R., 6, p. 1023).

Report of the veterinary department, A. W. BITTING (*Indiana Sta. Rpt. 1895, pp. 33, 34*).—Brief notes on the work pursued in this department during the year, special attention being paid to the antiseptic treatment of wounds and to the organisms producing septics; to the study of milk sickness, a disease resembling anthrax; notes on hog cholera in the State, and on 2 poultry diseases. The station herd was tested with tuberculin, the result being that 5 of the 28 cattle gave positive reaction and were found to be tuberculous on *post mortem*.

DAIRY FARMING—DAIRYING.

On the comparative feeding value of linseed meal, corn meal, and wheat bran for milch cows, F. W. WOLL (*Wisconsin Sta. Rpt. 1894, pp. 113–130*).—This experiment was made with 12 cows divided into 3 lots of 4 each. After a preliminary period of 1 week, the experiment was begun January 2, 1893, and was divided into 3 periods of 4 weeks each, separated by preliminary periods of 1 week. All the cows received throughout the test a basal ration consisting of 8 lbs. of oat hay, 4 lbs. of shorts, and yellow dent corn silage *ad libitum* (about 39 lbs. per head). In addition 4.2 lbs. of linseed meal, 4.1 lbs. of corn meal, and 4.1 lbs. of wheat bran per head per day were compared with each other in alternating periods. The composition of the feeding stuff used is given, together with full data for each cow for each period, including analyses of the milk. All the cows gained in live weight during the experiment from 6 to 79 lbs. per head.

"There was a gain in live weight on corn meal and on wheat bran over the weight of the cows while on linseed meal; as regards the water drank, the figures show that the cows drank most water while on linseed meal, less while on wheat bran, and least while on corn meal."

Concerning the composition of the milk, the author states that—

"On the average corn meal produced milk containing a lower percentage of fat and solids and a higher percentage of solids-not-fat than linseed meal; and produced

milk containing a lower percentage of solids, solids-not-fat, and fat than wheat bran; wheat bran produced milk containing a higher percentage of solids and fat and a lower percentage of solids-not-fat than linseed meal."

For the solids-not-fat the results were less uniform and the changes less marked.

Considering the effect of the different rations on the yield of milk and milk fat, the author says:

"These results do not show any material difference in the influence of the 3 concentrated feeds on the production of milk and fat under the conditions present in this experiment. Linseed meal gives a slightly better result than corn meal or wheat bran, and the latter 2 feeds give practically the same results, the main difference lying in the somewhat higher fat content of the milk on the bran feeding."

Microscopic examinations of the milk were made during the first 3 days of the first and fourth weeks of each period. The globules in 0.0001 cmm. and their relative size were determined. "The results would indicate that both wheat bran and linseed meal have a tendency to increase the size of the fat globules in cows' milk."

The following general conclusions are drawn:

"The data given show that under the conditions present in this experiment there was practically no difference in the immediate effect of the corn meal and the wheat bran on the yield of the milk, and that there was a small difference in favor of the linseed meal; as regards the production of fat, both linseed meal and bran give better results than corn meal, neither of these differences being, however, very marked.

"The plan of the experiment precludes a study of the effect of these foods beyond the time when they were fed."

The results are also discussed from a pecuniary standpoint, and the opinions of other investigators regarding linseed meal are quoted. The author believes that under the conditions ordinarily existing in the State linseed meal should only be fed in small quantities to cows, the bulk of the grain ration being made up of cheaper grains or refuse products from them.

Tests of dairy cows, J. W. DECKER (*Wisconsin Sta. Rpt. 1894, pp. 205-219*).—During 4 years the station made over 90 tests of cows, lasting from 1 to 7 days, for breeders and agricultural associations. The results of these tests are grouped in different ways and discussed:

"[In regard to the effect of age upon the quality of milk] the inference is that the difference between different ages is very small, if, indeed, there is any at all. In some cases where the same cow has been tested at different ages there is found a considerable difference in the percentage of fat in the milk, but the richer milk is sometimes found in the first and sometimes in the second test. If in such cases the influence of advancing lactation in improving the quality of milk is considered, most of the difference will disappear."

The record is given of 1 Jersey cow tested morning and night for 5 days, which showed wide variation:

"During the second day she gave 2¼ times as much fat as upon the first day, although the quantity of milk was increased only one-third. The greatest difference between any two milkings was found on the evening of the first day and the next morning, where the difference amounted to 5.8 per cent fat."

A herd of 8 cows, to which the above belonged, was tested morning and night for 5 days, the interval between the morning and night milkings being the same. The morning's milk was richer in 17 cases, the night's milk in 21 cases, and in the 2 remaining cases the morning's and night's milk were the same.

A number of tests were made of herds at home and at fairs. In the first, on a herd of 8 cows, which had only been brought some 3 miles to the fair, the yield of milk was practically the same at the fair grounds as at home, and the average fat content was 0.69 per cent less at the fair than at home. Two did better at the fair than at home, while with the others the reverse was true.

The second trial was with 2 Holstein cows which were taken by rail to fairs at different places in the State. There was practically no difference between the yield and composition of the milk at home and at the fair. A week later these cows were taken to the Indiana State Fair, and the week following to the Illinois State Fair. At the latter place they were tested. The results show that "there had been a great falling off both in yield of milk and in the per cent of fat, probably due to the fatigue and excitement of the journey."

The case is mentioned of a Jersey cow which gave 11 lbs. of milk with 10.7 per cent of fat at the fair grounds, and the next morning gave only 8.06 lbs. of milk with 7 per cent of fat. Another Jersey cow taken only a short distance to a fair gave during the night and morning following this 41.13 lbs. of milk with 2.46 lbs. of fat. In a 7-day test the following week the same cow averaged in 24 hours 41.71 lbs. of milk with 1.97 lbs. of fat.

"At no time during the home test did her milk contain as high a per cent of fat as at the fair, although the quantity of milk was about the same in both cases. The yield of fat during the week's test at home was 13.81 lbs. If she had given milk which averaged as rich as her test at the fair showed, she would have yielded 17.22 lbs. of fat during the week."

Cases showing the effects of other irregularities in treatment are mentioned.

The fat globules in cows' milk, F. W. WOLL (*Wisconsin Sta. Rpt. 1894, pp. 223–239*).—The results are given of microscopic examinations of the milk of cows in the World's Fair dairy test at Chicago and of the station herd. The work in connection with the World's Fair dairy test was done between August 26 and October 18, 1893. The official samples were used for this examination. Samples of the mixed morning's and evening's milk of the herd were examined daily for 4 consecutive days, and composite samples covering 4-day periods were examined in the case of the milk from single cows. The results of these examinations, together with other data relative to the yield of milk and fat and the percentage of fat from official sources, are fully tabulated for the 90-day butter test, the 30-day butter test, and the heifer test. The results are summarized.

"The data were obtained from 99 cows in all, and those of single determination from 58 cows. The average determinations of the milk from the different herds have been calculated, and were as follows:

Summary of examination of fat globules.

	Number of cows.	Average number of days from calving.	Number of globules in 0.0001 cmm.	Relative size.	Average diameter of globules.
Breed test No. 2 (90-day butter test); examinations made Aug. 26–29.					*Mm.*
Jersey	25	156	166	290	0.00395
Guernsey	25	151	190	217	.00358
Shorthorn	24	150	194	177	.00335
Average	....	152	183	228	.00363
Breed test No. 3 (30-day butter test); examinations made Aug. 30–Sept. 2 and Sept. 25–28.					
Jersey	15	142	144	337	.00415
Guernsey	15	121	164	267	.00384
Shorthorn	15	132	162	214	.00357
Average	....	132	157	273	.00385
Breed test No. 4 (heifer test); examinations made Oct. 1–4.					
Jersey	7	66	156	309	.00403
Shorthorn	6	107	80	504	.00479
Average	....	87	118	407	.00441
Average for all breeds and tests	....	128	157	289	.00391

"Twelve new cows were included in the test No. 3, and the number on the test decreased to 15 cows from each herd. In tests Nos. 2 and 3 the average size of the globules in the milk from the different herds was largest with the Jerseys, the Guernseys coming next, and the Shorthorns last. In the heifer test, on the other hand, the Shorthorns had the larger average globules, in spite of the fact that they were 41 days further advanced in the period of lactation than the Jersey heifers, which would naturally bring a diminution in the size of the globules. The average results for all herds and tests were 157 globules in 0.0001 cmm. and a relative size of 289, corresponding to an average diameter of 0.00391 mm., the results having been obtained with cows 128 days in milk."

Attention is called to the case of a Shorthorn cow apparently in good health, whose milk contained only 19 globules per 0.0001 cmm., the average relative size being 1982, *i. e.*, the average diameter of the globules was 0.00749 mm.

"If we calculate the average data of the determinations of the globules in the milk for the individual cows, considering the quality of milk produced by each animal in each case, we have the following statement:"

Average number and size of globules in milk of different breeds.

	Number of globules in 0.0001 cmm.			Relative size of globules.		
	Jersey.	Guernsey.	Shorthorn.	Jersey.	Guernsey.	Shorthorn.
Breed test No. 3.						
Herd milk (average of Aug. 30–Sept. 2 and Sept. 25–28)	144	164	162	337	267	214
Average for milk from single cows (average of examinations made Aug. 30–Sept. 23)	144	166	151	343	262	241
Breed test No. 4.						
Herd milk (average Oct. 1-4)	156	....	80	309	....	504
Average for milk from single cow (Oct. 1-4)	147	....	79	316	....	499

"The results are remarkably uniform and illustrate emphatically the correctness of the Babcock method of enumeration of fat globules in cows' milk."

The microscopic examinations of the milk of the university herd were commenced in 1888 (E. S. R., 2, p. 454), and were continued to the spring of 1894, when they were suddenly terminated by tuberculosis in the herd, which necessitated killing all but 2 of the cows. The main object was to study the influence of advancing age on the size and number of the fat globules. The data for the individual cows are tabulated in detail and are summarized for the beginning and end of lactation for different breeds and for different ages. The data for the beginning and end of the period of lactation are summarized below.

Fat globules in cows' milk at beginning and end of period of lactation.

Name.	At beginning of lactation period.						At end of lactation period.				
	Number of lactation periods included.	Number of globules per 0.0001 cmm.	Relative size.	Average yield of milk per day.	Average fat content of milk.	Days from calving.	Number of globules per 0.0001 cmm.	Relative size.	Average yeild of milk per day.	Average fat content of milk.	Days from calving.
				Lbs.	*Pr. ct.*				*Lbs.*	*Pr. ct.*	
Sylvia	4–2	137	360	21.38	4.76	17	298	185	11.55	5.28	268
Topsy	3–2	125	366	27.40	4.41	29	291	138	15.21	3.98	284
Bessie	3–2	164	363	19.45	4.85	25	404	151	6.90	5.78	263
Bunn	6–4	124	359	30.83	3.92	27	356	99	7.39	3.38	281
Mattie	2–2	172	210	27.02	3.55	20	404	101	15.15	3.45	204
Beauty	5–1	193	220	24.78	4.16	15	575	89	10.02	5.09	294
Sylvia 2d	1–3	103	450	24.10	4.62	21	308	197	9.16	5.75	302
Governor's Heifer	1–1	108	454	26.26	4.90	12	231	244	2.66	5.75	396
Daisy 2d	3–2	145	325	29.84	4.54	18	396	141	6.78	5.23	323
Rosette	4–2	131	423	17.14	4.96	15	271	198	3.87	5.33	299
Bessie 2d	3–1	150	352	21.83	5.15	16	337	188	9.48	6.24	331
Gay	4–2	112	483	20.42	4.89	15	220	203	7.73	4.38	257
Galena	4–1	179	272	28.45	4.73	13	404	115	15.56	4.33	288
Aaggie	3–2	115	260	37.88	2.92	13	376	109	2.55	4.13	395
Clothilde	2–2	159	198	38.54	2.69	12	767	64	12.88	2.77	203
Melvina	3–1	193	216	15.75	4.15	22	411	93	4.08	3.75	268
Cowslip	2–1	107	417	23.97	4.39	21	315	136	10.60	4.25	379
Bessine	1–1	93	542	33.40	5.04	15	259	230	6.82	6.22	355
Bryant	1–1	118	353	29.80	4.15	18	343	148	15.24	4.98	254
Average	......	138	348	26.22	4.26	18	367	149	9.14	4.64	297

"The average number of globules per 0.0001 cmm. for all cows is, at the beginning of the lactation period, 138, and at its end 367; the average relative size of the globules is 348 and 149 for the beginning and the end of the lactation period, respectively; the latter figures correspond to a diameter of the average sized globules of 0.00419 and 0.00316 mm., respectively."

The milk of 6 cows was examined for fat globules at the beginning of 4 consecutive periods of lactation, that of 12 cows at the beginning of 3 periods, and that of 16 cows at the beginning of 2 periods. At the end of the lactation period the milk of 2 cows was examined for 3 years and of 11 cows for 2 years.

"[The results as tabulated] fail to disclose any striking difference as to the influence of advancing age on the fat globules in milk. The tendency seems to be toward fewer globules and a somewhat larger size with increasing age at the beginning of the period of lactation, and at its end the opposite seems to hold true. The differences found are, however, not very marked."

The data obtained in connection with the World's Fair test are also tabulated according to the age of the cows. Although there was considerable difference in the average time since calving, "the general tendency seems to be toward a slightly increased number of globules per unit of milk with increasing age, and a similar decrease in the average size of the globules."

The sources of bacterial infection and the relation of the same to the keeping quality of milk, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1894, pp. 150–165, figs. 3*).—The sources of infection are discussed in a popular way under the heads infection from unclean vessels, from foremilk, from animal and milker, and from the barn air, and some experiments are given bearing on these points. As showing the advantage of sterilizing milk vessels with steam, covered milk pails were used, one of which had been cleaned in the ordinary way and the other sterilized with steam for half an hour. The udder of the cow was thoroughly washed, the hands of the milker cleaned, and the first portion of the milk was rejected. Gelatin cultures of the milk drawn in each pail showed 165 germs per cubic centimeter in the milk from the sterilized pail and 4,265 germs per cubic centimeter in that from the pail cleaned in the ordinary way. The latter soured in 23 hours, while that in the sterilized pail remained sweet 5½ hours longer.

"Numerous repetitions of the same method of procedure often showed still greater differences, in some cases there being a difference of 15 hours in the length of time before the milk began to turn. These experiments were confined entirely to the milking vessels, but the same influences are at work in connection with all other kinds of dairy utensils. Cans in which the milk is set for creaming, all dippers, and strainers should be rendered as germ free as possible, so that the number of organisms added to the milk will be reduced to a minimum. Under average conditions, it may be confidently asserted that, with this simple precaution alone, the marketable period, *i. e.*, the length of time during which milk remains sweet, may be extended from 6 to 10 hours."

In another experiment the milk drawn first from each duct was kept separate in a sterile flask. This was found to contain 2,800 germs per cubic centimeter, while the remainder of the milk averaged only 330 germs.

"The character of the bacteria in each sample presented marked differences; those in the foremilk belonged to a single species of the lactic acid group of organisms, while those in the mixed milk were included under several different forms, the majority of which belonged to the rennet-forming species that produce such profound changes in the character of the milk."

The cow and the milker are shown to be important sources of infection, and it is recommended that the udder and flank of the cow be well carded and brushed, the udder washed, and the hands of the milker cleaned with soap and warm water immediately preceding milking. "It is also well to have the milker, especially the upper portion of his body, clothed in an outer garment kept for this purpose."

Numerous experiments are reported in regard to this matter, the method being to expose a gelatin culture dish underneath the cow at

the height of the milk pail and in close proximity to the same while the milking is in progress. The results of some of these experiments are summarized below:

Effect of washing udder on the bacteria in milk.

Date.	Treatment of cows.	Estimated number of bacteria deposited per minute on 78 sq. in. of surface (10-inch milk pail.) Ordinary conditions.	Udder and flank washed.	Reduction of organisms.
				Per cent.
November 6	Stabled	16,400	2,600	85
November 10	....do	4,010	1,860	54
	....do	1,700	560	66
November 24	....do	4,165	1,370	69
February 20	....do	1,800	1,300	27
March 3	....do	2,700	330	88
August 23	Pastured	3,260	114	96

During the last trial the germs due to those floating in the air were checked by exposing a plate to the air under similar conditions.

"While 114 germs were deposited under the cow, 65 were found on the plate exposed simply to the air. The extent of diminution is therefore really greater than would appear from the foregoing table."

In feeding hay, straw, or coarse dry fodder the barn air is much infected with dust particles to which bacteria are attached in large numbers. A gelatin plate exposure made in the stalls during the feeding showed that over 160,000 organisms were deposited in a minute on an area covered by an ordinary milk pail.

"These settle with the dust, and in doing so inevitably gain access to the open milk vessels. In this way the hay bacillus and allied forms that are of a resistant character find their way easily into the milk. This source of danger can be eliminated by feeding moistened feed during the milking, or the dry feed immediately subsequent to this operation but after the milk has been removed from the stable."

It is stated that by observing the precautions as to cleanliness mentioned above "the keeping quality of the milk may be increased to such an extent that it will remain sweet from 24 to 48 hours longer than it otherwise would."

"The following example shows to what extent the bacteria of the milk can be controlled by rational methods of milking: In October the mixed milk taken in the ordinary way was found to contain 15,500 germs per cubic centimeter, while the average of the total yield of a cow that had been carefully cleaned and the milking done in the manner already suggested contained only 330 bacteria for the same volume. In February, under winter conditions, a repetition of the same experiment revealed a still smaller number, there being 7,680 germs per cubic centimeter in the mixed milk, while that received in open sterile pails, but with greater care, had only 120 bacteria for the same volume. . . .

"At room temperature there was a difference of 24 hours in time before both soured in favor of the milk secured with this extra care."

The relation of temperature to the growth of germs is pointed out, and it is recommended that milk be cooled immediately after it is drawn from the cow and kept at the lowest possible temperature, at least below 50 to 60° F.

Effect of salt upon cheese, J. W. DECKER (*Wisconsin Sta. Rpt. 1894, pp. 220–222, fig. 1*).—Two experiments are reported on this point. In the first 31.5 lbs. of curd was divided into 3 equal portions, the first receiving no salt and the second and third salt at the rate of 1.5 lbs. and 3 lbs. of salt per 100 lbs. of curd, respectively. The yield and composition of the cheese are shown in the following table:

Effect of salt upon composition of cheese.

	Weight of curd.	Amount of salt per 100 lbs. curd.	Weight of green cheese.	Weight of cheese when analyzed.	Water.	Ash.	Salt.	Ash not salt.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Cheese No. 1	10.5	None.	10.00	9.4	34.12	2.38	0.05	2.33
Cheese No. 2	10.5	1.5	9.75	9.2	31.35	3.15	.65	2.50
Cheese No. 3	10.5	3.0	9.50	8.9	29.82	3.85	1.17	2.68

The difference in yield "is due to the more thorough expulsion of moisture from the salted curd." When 4 weeks old these cheeses were cut. No. 3 was found to be the best and had cured more slowly.

A second experiment made in the same way, except that No. 2 was salted at the rate of 2 lbs. per 100 lbs. of curd, gave practically the same result as the first experiment.

"At my suggestion a former student in this school conducted experiments by dividing curds and salting them at rates from 2.25 to 3 lbs. per 100 lbs. of curd. In every case the judgment of the buyer was that the last lot was best, both in texture and flavor.

"As a result of our experiments we conclude:

"(1) Only a trace of the salt originally in the milk is retained by the cheese.

"(2) Salt applied to curd diminishes the yield of cheese by expelling moisture.

"(3) Increasing the amount of salt makes the cheese cure more slowly, and up to about 3 lbs. of salt per 100 lbs. of curd cheese of better texture and flavor is obtained."

Experiments in the manufacture of cheese, S. M. BABCOCK (*Wisconsin Sta. Rpt. 1894, pp. 131–149*).—These experiments were mostly made in connection with the Wisconsin Dairy School, the work being largely done by students under the direct supervision of an instructor.

Influences of fat upon the yield of cheese (pp. 131–134).—Seventy trials were made in different years, in each of which a lot of mixed milk was divided into two parts, a portion or all of the cream from one part being removed by a separator, and sometimes a portion of it added to the other lot of milk. Cheddar cheese was made from both lots, the treatment being as nearly uniform as possible.

"The average result obtained in this way in 70 trials in which the fat in the milks compared differed by one or more per cent, gives 1.07 lbs. of green cheese as the apparent yield of 1 lb. of fat. The range was from 0.81 lb. to 1.52 lbs., but most of the trials gave figures which were near the average.

"The actual amount of green cheese which 1 lb. of fat in these milks has contributed is greater than this by the amount of cheese made from 1 lb. of milk serum. This is evident because 1 lb. of serum in the poorer milk has replaced each pound of fat removed from the rich milk, and in the calculation the cheese produced from the serum has been subtracted from the yield of the rich milk. In these experiments each pound of serum has yielded a little less than 0.06 lb. of green cheese, which added to 1.07, the apparent yield from 1 lb. of fat, gives 1.13 as the actual amount of cheese produced from 1 lb. of fat, which is approximately the same as the yield of butter from the same amount of fat. As only about nine-tenths of the fat in the milk is recovered in the cheese, it follows that 0.9 lb. of fat holds mechanically in the green cheese a little more than 0.2 lb. of whey, which is very nearly the same relation that exists in butter between the butter fat and the other constituents."

Assuming that the milk used in these tests contained 2.4 per cent of casein, the yield of green cheese was 2½ times the casein; "that is, each pound of casein in the milk will produce on the average 2½ lbs. of green cheese, 1½ lbs. of which is whey held mechanically in the curd." Applying the above values to fat and casein, the following rule is worked out for calculating the yield of green Cheddar cheese from the composition of the milk:

"The yield of green Cheddar cheese from 100 lbs. of milk is equal to 1.1 times the per cent of fat added to 2.5 times the per cent of casein in the milk. This rule was suggested by the writer to Dr. Van Slyke nearly 2 years ago, and it has been used by him in all of his cheese work since with most satisfactory results.

"The rule is applicable to all milks, even when they are watered, skimmed, or enriched by adding cream.

"The yield of green cheese from 100 lbs. of milk may be roughly estimated without a complete analysis of the milk by adding 5.9 to 1.1 times the per cent of fat in the milk. The cured cheese 30 days old may be found approximately by adding 5.7 instead of 5.9 to 1.1 times the per cent of fat. This last rule does not apply to watered milk; it also will vary some with the season of the year and with the per cent of fat in the milk."

Influence of fat on the quality of cheese (pp. 134–137).—Several experiments were made to determine the relation between the fat in the milk and the quality of the cheese as measured by the price it commands in the market. In each case two separate lots of milk were used, cream being added to one portion to make a difference of 2 or more per cent in the fat. The trials were made in March, and the cheeses were kept until October, when they were 6 or 7 months old, and were then shipped to Chicago where they were judged as to value. There was so much difference in the value fixed by different judges that the results were not altogether satisfactory.

"In general, it may be said that the cheese made from the richer milk was valued 1 or 2 cts. per pound higher than that made from the poorer milk. In 2 cases there was enough rich milk to make 2 cheeses weighing about 60 lbs. each, only one of which was scored by the judges. The extra cheesees were sold to a retail grocer for 15 cts. per pound, and were sold by him to customers at 20 cts. per pound. We could have sold tons of such cheese at the same rate; one grocer in Chicago would have taken a large quantity, and a number of requests were received from individuals for cheese of this kind."

The results of the experiments, together with the values placed upon the cheeses by an expert who examined them a day or two before they were sent to Chicago, and whose figures were quite consistent with the prices actually obtained, are given in the following table:

Yield of cheese and loss of fat per 100 lbs. of milk, and value of cheese from rich and poorer milk.

No.	Date.	Fat content of milk.	Fat in whey.	Total loss of fat in whey and press drainings.	Yield of cheese. Green.	Yield of cheese. Cured.	Fat content of cheese (calculated).	Value of cheese per pound.	Price per pound of fat in milk.	Value of added fat per pound.
	1891	*Per ct.*	*Per ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Per ct.*	*Cents.*	*Cents.*	*Cents.*
1	Mar. 27	2.70	0.25	0.270	8.375	7.53	32.3	8.0	22.3	35.4
2	....do ...	4.35	.40	.398	10.550	9.50	41.6	12.5	27.3	
3	Mar. 28	2.90	.28	.268	8.823	8.00	32.7	8.0	22.1	35.2
4	....do ...	4.55	.40	.379	10.708	9.77	42.6	12.5	26.9	
5	Mar. 30	3.15	.32	.295	8.937	8.00	35.4	8.0	20.3	24.6
6	....do ...	6.20	.59	.583	12.500	11.14	50.4	12.5	22.4	
7	Mar. 31	3.00	.37	.529	8.882	8.06	30.6	8.5	22.8	27.8
8	....do ...	4.85	.46	.635	10.936	9.99	42.2	12.0	24.7	

"From the figures given it is apparent that in every case the quality of the cheese has improved with the increase of fat in the milk, and that this improvement has more than compensated for the value of the extra fat in the richer cheese. It is not, however, proven by this that it paid to add cream to milk for the richer cheese. . . .

"It does show that skimming the milk resulted in a loss, as the fat abstracted was worth more in cheese than it would have been in butter. At this time butter was worth in Chicago about 29 cts. per pound. It is probable that with the prices given, viz, 10.5 cts. for cheese and 29 cts. for butter, it would have paid better to have skimmed off all of the cream and made butter of it than to have made the milk into cheese. It may be stated as a general rule that it never pays to skim off part of the cream and make both butter and cheese, and further that whenever the price of butter exceeds 2½ times the price of cheese it will pay better to make butter than cheese, no account being taken of the difference in value of the skim milk and whey. If the relative value of skim milk and whey be taken into account, butter should pay better than cheese whenever its price exceeds 2¼ times the price of cheese; under other conditions cheese should pay better than butter."

The yield of cheese in factories from different qualities of milk and in different seasons of the year (pp. 137–144).

"All students who are candidates for dairy certificates from our school are required to send to us monthly reports of their work for one or two seasons. The reports from cheese factories give, along with other data, the average percentage of fat in the milk and the average yield of cheese. During the past 4 years there have been received 347 reports from cheese factories in which both the percentage of fat in milk and the yield of cheese are given.

"In the following table are given averages of these reports, arranged according to the percentages of fat and also according to the season of the year:

Yield of cheese in factories according to percentage of fat in milk.

Group.	Number of reports.	Fat content of milk.		Average yield of cheese per 100 lbs. milk.	Yield of cheese for 1 lb. fat.
		Range.	Average.		
		Per cent.	*Per cent.*	*Pounds.*	*Pounds.*
No. 1	24	Under 3.25	3.126	9.194	2.941
No. 2	90	3.25-3.50	3.382	9.235	2.730
No. 3	134	3.50-3.75	3.600	9.407	2.613
No. 4	43	3.75-4.00	3.839	9.806	2.562
No. 5	46	4.00-4.25	4.090	10.300	2.512
No. 6	20	Over 4.25	4.447	10.707	2.407
All groups	347	....	3.64	9.566	2.628

Yield of cheese in factories by months.

Month.	Number of reports.	Average fat content of milk.	Average yield of cheese per 100 lbs. milk.	Yield of cheese for 1 lb. of fat.
		Per cent.	*Pounds.*	*Pounds.*
April	22	3.480	9.154	2.630
May	68	3.493	9.447	2.704
June	66	3.497	9.367	2.679
July	63	3.554	9.231	2.593
August	49	3.634	9.335	2.568
September	36	3.836	9.955	2.594
October	28	4.076	10.562	2.591
November	15	4.254	10.947	2.573
Whole season	347	3.64	9.566	2.628

"If the figures can be depended upon they indicate that the yield of cheese is greater from rich milk than from poor milk, that if the season be left out of consideration the yield from rich milk is not as large in proportion to the fat as it is from poor milk, and finally that both the fat in the milk and the yield of cheese increases in nearly the same proportion as the season advances.

"Because most cheese factories are closed during the winter it is customary in cheese districts to have, so far as practical, cows fresh in the spring. Such being the case, the increase in the percentage of fat in the milk and the increase in the yield of cheese from month to month, shown in the second of the above tables, may be attributed to advancing lactation."

The data are also arranged so as to compare milk containing different amounts of fat at the same season of the year, and the conclusion is reached that—

"At the same season of the year rich milks do not yield as much cheese in proportion to the fat which they contain as do poor milks, but that a rich milk toward the end of the season may do as well as a much poorer milk earlier in the season.

"Dr. Van Slyke, from a long series of carefully conducted experiments at New York cheese factories, has concluded that the yield of cheese from 100 lbs. of normal factory milk is very nearly proportional to the percentage of fat in the milk.

"It appears to the writer that the discrepancy is only apparent, and arises from the fact that in Dr. Van Slyke's experiments the poor milks used have nearly all been early in the season and the rich milks toward the end of the season, the

gradation from one to the other having been gradual, so that when the results are arranged according to the fat in the milk they are virtually arranged according to season, as is done in the second table above with the students' reports. . . .

"With this explanation there is nothing inconsistent in the work done by Dr. Van Slyke and the results arrived at from the students' reports. In fact the two tend to confirm each other."

The relation of these facts to the payment for milk at cheese factories is discussed and a table is given showing the yield, composition, and value of cheese from milk containing different percentages of fat, and the amount to be paid for such milk according to the "pooling" plan and the relative-value plan. In the relative-value plan payment is made on the basis of 26.8 cts. per pound for the fat in the milk, this being the value obtained by dividing the total value of the cheese by the amount of fat in the milk. The cheese is valued according to its richness in fat, rating full-cream cheese at 10 cts. per pound, and for each 4 per cent less of fat in the lower grades deducting 1 ct. per pound of cheese.

"The close agreement between the value of the cheese calculated from the market reports in the manner described and that given by the relative-value plan is strong evidence that the latter is approximately correct. . . .

"The justice of the method is no longer questioned in creameries, in which it has been almost universally adopted, and it is believed by the writer that the plan will be equally acceptable in cheese factories so soon as its relations to all sides of the question are better understood."

Loss of cheese in curing (pp. 144–146).—This gives a summary of the observations made at the dairy school on the loss in weight of 1,235 cheeses during curing under favorable conditions. The cheeses were all made by the Cheddar process, and were mostly pressed in flat hoops and had an average weight of about 30 lbs. when green. A summary by groups according to the time of curing is given as follows:

Average loss of cheese in curing.

Group.	Period covered.	Average age.	No. of cheese.	Total weight.		Loss.	
				Green.	Cured.	Pounds.	Per cent.
	Days.	*Days.*		*Pounds.*	*Pounds.*		
No. 1	1–10	6	99	2,812.0	2,741.5	70.5	2.51
No. 2	11–20	16	242	7,356.9	7,077.0	279.9	3.80
No. 3	21–30	25	298	8,530.5	8,160.4	370.1	4.34
No. 4	31–60	41	417	12,353.3	11,684.4	668.9	5.41
No. 5	Over 60	141	172	6,244.4	5,736.0	508.4	8.11

"The table shows that the loss in a given time is very much greater in the early stages than it is later, it being fully half as much during the first week as for the whole month and more than one-quarter as much as for 5 months."

Cleaning milk with a centrifugal separator for cheese production (pp. 146–149).

"In the manufacture of cheese all solid matters contained in the milk are entangled in the curd and finally carried into the cheese, and it is reasonable that removal of slime from milk used for this purpose would be especially beneficial."

Experiments were made to test this point, nearly 100 cheeses being made from milk cleaned in this way.

In experiments in the winter it was found that any tendency to gassy or pin-holey curds was either entirely removed or greatly improved by cleaning the milk; but during the summer gassy or pin-holey curds were not prevented by this cleaning. In experiments in which milk was cleaned with a separator and the slime removed from 2 lots of milk added to 1 lot, the curds from both lots were practically free from pin-holes, and "it seems likely that the suppression of pin-holes by passing milk through a separator was due to the aëration, and not to removal of gas-producing organisms in the slime."

Although cleaning the milk by means of a separator has not accomplished all that was hoped, it is believed to have been of great benefit, and in nearly every case it improved the quality of the cheese, the improvement being more marked with tainted milk than with milk in good condition. "Especially has it been of benefit for long-keeping cheese. All such has retained its flavor much better when made from separator-cleaned milk."

"The yield of cheese by this process is a trifle smaller than from untreated milk, it being on the average about 0.2 lb. less from 100 lbs. of milk. The loss of fat in whey is also a little higher. The difference is, however, more than balanced by the better quality of the product."

One hundred rations for dairy cows, F. W. WOLL (*Wisconsin Sta. Rpt. 1894, pp. 86–112*).—This is largely a reprint of Bulletin 38 of the station (E. S. R., 5, p. 884).

Hygiene of domestic animals in the production of milk, C. PAGÈS (*Paris: G. Masson, Libraire de l'Académie de Médecine, 1896, pp. 324*).

Test of cream separators, H. H. WING (*New York Cornell Sta. Rpt. 1894, Appen., pp. 161–174, pl. 1*).—A reprint of Bulletin 66 of the station (E. S. R., 6, p. 245).

The Babcock milk test, W. J. SPILLMAN (*Washington Sta. Bul. 18, pp. 27, figs. 5*).—This is a working description of the Babcock test and method of using it, the application of the test to paying for milk at creameries, and the relative-value plan. Compiled data are also given of the average composition of dairy products, the distribution of ingredients in butter and cheese making, etc. The percentage of fat in the milk of 2 cows tested morning and night for 2 weeks is given, showing the variation.

Analyses of milk and cream, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 120, 121*).—The percentages of fat in 30 samples of milk of unknown origin, and in 78 samples of Ayrshire milk classified according to fat content are reported, together with solids and fat in 5 samples of Holstein milk, 2 samples of mixed-herd milk, and 2 samples of cream from a coöperative creamery.

Dairy experiments, A. H. WHEATON (*South Dakota Sta. Rpt. 1894, Bulletins, pp. 20*).—Bulletin 39 of the station (E. S. R., 6, p. 338) is bound with the Annual Report.

TECHNOLOGY.

Maple sap studies, F. W. MORSE (*New Hampshire Sta. Bul. 32, pp. 16, figs. 2, dgms. 2*).—The studies of maple sap, which were reported in Bulletin 24 of this station (E. S. R., 7, p. 92), were continued by the author, assisted by E. P. Stone. The results given in the present bulletin are in accord with those expressed in the previous one and serve

to emphasize the statement that more sap flows from a deep hole than from a shallow one. The common practice of retapping trees toward the end of the season in order to secure a longer flow of sap seems to be sound, as shown from experiments detailed in this bulletin. The study of the composition of the sap from different depths in the tree gave contradictory results. Determinations were made of the glucose and ash, from which it appears that the average glucose content in one tree was 0.0075 per cent, and in another 0.0123 per cent. The maximum results were obtained in the early part of the season. Ten estimations of the ash of the sap were made from 2 trees, and the average amount present was found to be 0.051 and 0.052 per cent, respectively.

Investigations of maple sap, sirup, and sugar, A. H. WOOD and F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 132–151*).—This is a continuation of work published in Bulletin No. 25 of the station (E. S. R., 7, p. 162). The tabulated data includes the general range in percentage of saccharose found in sap of various trees during 3 years, relation of saccharose to total solids, variation in composition of sap from different sides and parts of a tree, and from outer and inner wood, relation of depth of tapping to flow of sap, flow of sap from north and south sides of trees, effect of tapping trees once and twice, and composition of maple sirup and sugar.

The range in percentage of sugar was very wide, the richest sap coming from fully developed trees. There was a decrease in the percentage of sugar as the season advanced. The average of 9 determinations of the specific gravity of sap in 1893 was 1.0143; the average of 10 determinations of the reducing sugars in 1892 was 0.0064 per cent, and of 12 determinations of ash was 0.0247 per cent. In the trials so far the sap from the north side was richest, and sap from the trunk was richer than that from the branches. Deep tapping gave more sap than shallow, and tapping on the south side gave more than on the north side. Tapping twice close together showed no advantage. Sirups from soft maples were inferior in color and flavor to those from rock maples.

Cotton-seed industry in the South, E. L. JOHNSON (*Sci. Amer., 75 (1896), No. 20, p. 363*).—A popular article.

On the artificial addition of carbonic acid to ordinary still wines, E. MACH (*Tirol. landw. Blätter, 15 (1896), Nos. 16, pp. 146–148, figs. 3; 17, pp. 157–159*).

Studies on vinification and on the refrigeration of musts, A. MÜNTZ and E. ROUSSEAUX (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 321–373, fig. 1*).

Analyses of cider, F. W. MORSE (*New Hampshire Sta. Rpt. 1894, pp. 125, 126*).—The specific gravity, solids, alcohol, sugar, free acids, albuminoids, ash, and carbonic acid are reported for 6 samples of bottled cider, some of which had been treated to retard fermentation.

Improved processes in cider making (*Amer. Agr. (mid. ed.), 1896, Sept. 26, pp. 266, 267*).

General meeting of the Union for Beet-sugar Industry in the German Empire at Munich, June 11 and 12, 1896 (*Chem. Ztg., 20 (1896), No. 52, pp. 512, 513*).—The following points were discussed: (1) What is the cause of the dark coloring of the juice so often noticed in the last season, and has this any connection with the strik-

ing increase in alkalinity during evaporation? (2) Does the use of sulphurous acid in the thick juice insure without disadvantages a lighter color of the first product? (3) What may be expected of the new Steffens method of handling beet juice? (4) The limestone material of the German sugar factories. (5) The causes of the decrease in sugar by long storage. (6) Relation of the sugar and ash content to the purity coefficient in sirups and molasses. (7) Molasses production. (8) The normals in sugar-beet seed trade. (9) The result of feeding experiments with beet leaves (E. S. R. 8, p. 252).

Beet sugar, methods of producing, etc., by a number of countries (*Southern Cultivator, 15 (1896), No. 10, p. 3*).—Statistics on the beet sugar production of Germany, France, and the United States.

AGRICULTURAL ENGINEERING.

Surface and subirrigation out of doors, F. W. RANE (*New Hampshire Sta. Bul. 34, pp. 27, figs. 8*).—This is an account of a continuation and extension of the work of the author on subirrigation in the greenhouse, reported in Bulletin 33 of the West Virginia Station (E. S. R., 5, p. 680), undertaken in view of the growing importance of outdoor irrigation in the East and the lack of definite information on the subject. The reasons for irrigation, sources of water supply, and economy of water are discussed. The relative merits and disadvantages of surface and subirrigation are explained and experiments with each in the greenhouse and out of doors are described, with directions for the laying of tiles in the latter method and suggestions regarding cultivation, mulching, and drainage.

"Where plenty of water is available we believe the best and most satisfactory results are secured by applying the water where needed through ditches. . . .

"Three thousand six hundred and thirty cubic feet, or about 800 bbls., of water is the amount estimated to cover 1 acre of ground to a depth of 1 in.—the amount recommended per acre for reservoir capacity. . . .

"There are many instances where surface irrigation will be found the most economical, not only where plenty of water is to be had, but where economy of water is necessary. There are more advantages in favor of this method than are attributed to it. After having experimented with subirrigation at various depths and upon different soils, I would recommend caution before going into irrigation on a very extensive scale, believing that the extra expense in purchasing and laying tiles will more than offset the expense of labor in surface irrigation.

"Experiments with celery upon a clay loam, with water applied both through ditches for surface irrigation, and through tiles below the reach of the plow for subirrigation, showed that the latter system required much more water than the former for the same results.

"By taking advantage of the cloudy portions of the day and as well the shade from the foliage of the plants, the loss from evaporation in surface irrigation is greatly lessened.

"The percentage of water saved in subirrigation out of doors is greatly reduced on account of its soaking off in the soil below.

"The fact that the tiles are out of sight and their action unknown makes ordinary subirrigation a little uncertain."

[A method of tile irrigation which the author has found to possess decided advantages over ordinary subirrigation] "was to place common porous $2\frac{1}{2}$-inch drain tiles in a continuous row, end to end, on the surface of the soil, vegetables being planted

on either or both sides of the line. The tiles were 1 ft. long, and by pouring in the water at one end of the line it was distributed at the joints throughout the length desired when the opposite end was stopped up. Take celery as an example crop for irrigation on uplands. We plant the celery as above stated, and while it is young we have simple surface irrigation; but as the crop grows we bank it up, and finally have the tile covered, and thus have subirrigation. The tiles are cheap and last indefinitely. When the celery is harvested, the tiles are dug out also and piled up or used for subirrigation in the greenhouse beds. Potatoes and various other crops can be grown in the same way. The celery watered this year grew well and did not rust. Besides this, we were able to water 20 times as much space in the same time as in the ordinary way with ditches. Besides saving time, this plan delivers water where it is most needed, and we have reason to believe is fully as economical with water as with time."

Experiments during 2 seasons have shown that with this method "the plants did fully as well as in the other systems and with less water."

"Onion seed sown upon upland, with and without irrigation, gave marked results in favor of irrigation, [but] to get the best results cultivation goes hand in hand with irrigation. Mulching and subsoiling are milder forms of irrigation which can be resorted to with good results to counteract drought.

"Many soils need drainage, perhaps, rather than irrigation, while in some others there is a medium which gives best results."

Money value of good roads to farmers, W. C. LATTA (*U. S. Dept. Agr., Office of Road Inquiry Circ. 23, pp. 4*).—"Letters of inquiry were sent to 60 of the most intelligent farmers in 40 counties located in the central and northern parts of the State." From the 40 replies received the following approximate averages were obtained:

"(1) The average estimated increase in the selling price of land due to existing improved highways is $6.48 per acre. The estimates from which this average is made refer in most cases to lands near the improved roads; but in a few instances they apply to all the lands of the county. The average increase, therefore, of $6.48 per acre is lower than was intended for the lands near the improved roads.

"(2) The estimated average increase per acre that would result from improving all the public roads is $9.

"(3) The estimated average cost of converting the common public roads into improved highways is $1,146 per mile.

"(4) The estimated average annual loss per 100 acres from poor roads is $76.28."

Small lateral pressure of silage after settling has ceased, F. H. KING (*Wisconsin Sta. Rpt. 1894, pp. 289, 290, fig. 1*).—An account of 2 burned silos is given, whose contents still remained in place after all support had been thus removed. This shows the absence of lateral pressure after settling and the necessity of rigid silo walls to prevent the formation of air spaces between silage and walls and the consequent loss by fermentation.

Scales used for heavy weighing (*Wisconsin Sta. Rpt. 1894, p. 291, fig. 1*).—The scales used in weighing cylinders of soil are described and figured. It consists of a steelyard of 1,000 lbs. capacity, having a beam graduated to tenths of a pound and provided with a knife-edge at the end of which to hang additional weights.

Farm drainage, C. G. ELLIOTT (*U. S. Dept. Agr., Farmers' Bul. 40, pp. 24, figs. 6*).—A popular treatise on this subject, including the following topics: Texture of soils and its relation to their drainage; natural and artificial drainage; surface drainage and underdrainage; tile drainage, including distance apart and depth of underdrains, kind of tiles, size of tiles to be used, how to locate drains, surveys and grades, digging and grading the trench, grading from a survey, laying the tiles, filling the trenches, action to be expected from underdrainage, cost and profit of tile drainage; open drains, cost, and classification for assessment purposes; and construction of open ditches.

What quantities of water should be carried off by drainage? E. FRAISINET (*Fühling's Landw. Ztg., 45 (1896), No. 14, pp. 451–455*).

Drainage in practice and theory; different methods of digging ditches; drainage of water courses (*Anal. Sociedad Rural Argentina, 30 (1896), No. 1, pp. 9–16, figs. 16*).

Protecting the banks of streams, A. RONNA (*Jour. agr. Prat., 60 (1896), II, No. 35, pp. 309–312, figs. 4*).

Experiments with water lifts, A. CHATTERTON (*Dept. Land Records and Agr., Madras, Bul. 32, pp. 14, pls. 2*).—This is a report of official tests of 3 forms of animal-power windlasses in common use in India for raising water for irrigation and other purposes.

The proper time to apply water—cultivation, T. S. VAN DYKE (*Irrigation Age, 10 (1896), No. 4, pp. 126–129*).

The South Dakota artesian basin, F. F. B. COFFIN (*Irrigation Age, 10 (1896), No. 2, pp. 71–73*).

Storage reservoir sites and canals, F. C. FINKLE (*Irrigation Age, 10 (1896), No. 2, pp. 77, 78*).

The irrigation of hillsides—winter irrigation, T. S. VAN DYKE (*Irrigation Age, 10 (1896), No. 2, pp. 74–77*).

The influence of irrigation on climate and health, W. L. WOODRUFF (*Irrigation Age, 10 (1896), No. 2, pp. 67–70*).

Method of constructing macadamized roads (*U. S. Dept. Agr., Office of Road Inquiry Circ. 21, pp. 12*).—This is an abstract of a report by the chief engineering inspector of the Local Governing Board of England, prepared in compliance with the request of the California Bureau of Highways for information regarding "the methods employed in England in the matter of highway improvement."

Good roads for Pennsylvania, J. HAMILTON (*Pennsylvania Dept. Agr. Bul. 12, pp. 42, figs. 6*).—This article "is in no sense an exhaustive discussion of the question, but is intended simply to call the attention of supervisors and others interested in road construction to some facts and methods which the writer has found by experience to be practicable under our present conditions, and which it is believed will, if carried into operation, speedily bring about a change for the better in the roads of the Commonwealth."

The following topics are briefly discussed: How much road does Pennsylvania have? What is a good road? How to maintain a good road; suggestions; how to construct a clay road; material for ballast; implements for road building and repairs; wide tires; breakers; table of grades; table of traction; repairing; management in winter; mortgaging township; cost of crushing and distributing stones; cost of earth roads; road taxes levied in the townships of Pennsylvania; and appropriations by counties for roads and bridges. Various machines useful in road construction are illustrated.

The preservation of posts, L. DANGER (*Landw. Wochenbl. Schles. Holst., 46 (1896), No. 34, pp. 483–485*).—The application of crude petroleum and chlorid of zinc, petroleum alone, and sulphate of copper, or charring is recommended.

Self-acting drinking contrivances, SCHACHT (*Landw. Wochenbl. Schles. Holst., 46 (1896), Nos. 30, pp. 435–442, figs. 19; No. 37, pp. 530–535, figs. 13; Deut. landw. Presse,*

23 (1896), No. 77, p. 691, figs. 7).—An illustrated article giving various ingenious devices for supplying stock continuously and automatically with clean drinking water.

The electric plow and sugar manufactories, F. BRUTSCHKE (*Deut. landw. Presse, 23 (1896), No. 79, pp. 706, 707*).—The author says that the problem of the electric plow is solved.

More about stock scales (*Breeders' Gaz., 29 (1896), No. 19, pp. 345, 346*).

A furrow maker, J. SHOMAKER (*Irrigation Age, 10 (1896), No. 2, pp. 80, 81*).

The cultivators and weeders at the provincial agricultural fair at Moulins, M. RINGELMANN (*Jour. agr. Prat., 60 (1896), II, No. 34, pp. 269–273, figs. 2*).

Report of experiments carried on at the station for testing agricultural machines, M. RINGELMANN (*Bul. Min. Agr. France, 15 (1896), No. 3, pp. 392–428, figs. 5, dgms. 16*).—These experiments embrace 137 trials with 5 kinds of grain drills, grain grader, apparatus for cooking food for stock, apple crusher, press, investigation of the transmission of pressure in presses, force pump, and mechanism for barometric indicator.

STATISTICS.

Crop reports for June, July, and August, 1896 (*U. S. Dept. Agr., Division of Statistics Rpts., n. ser., 138, pp. 4; 139, pp. 8; 140, pp. 8*).—These reports include the usual summaries of condition of farm crops and fruit, with reports from European countries.

Manual of instructions to crop correspondents, H. A. ROBINSON (*U. S. Dept. Agr., Division of Statistics, pp. 23*).—This is a revised and corrected copy of a manual designed for the guidance of the crop correspondents in replying to the circulars of inquiry sent to them. Its purpose is to secure a systematic and uniform method of crop reporting. General suggestions are given as to the persons to whom returns are to be made, followed by instructions as to the method of reporting for each month, and closing with a general discussion of the meaning and application of the standard 100, and a comparison with the standard of India, which is 16.

Sixth Annual Report of Arizona Station, 1895 (*Arizona Sta. Bul. 19, pp. 8*).—This includes a financial report for the year ending June 30, 1895, list of all bulletins issued by the station, and report of the director upon work of the year, bulletins issued, and donations and exchanges received.

Eighth Annual Report of Colorado Station, 1895 (*Colorado Sta. Rpt. 1895, pp. 65–164*).—This includes a financial statement for the fiscal year ending June 30, 1895, the director's report and criticisms of the methods of station work, brief reports by the heads of the different sections, and more detailed accounts of work done at the substations.

Annual Report of Idaho Station, 1895 (*Idaho Sta. Rpt. 1895, pp. 5*).—Report by the director on progress of work at the station, and a financial statement for the fiscal year ending June 30, 1895.

Annual Report of Indiana Station, 1895 (*Indiana Sta. Rpt. 1895, pp. 44*).—This contains reports by the director and heads of departments of the station, some of which are referred to elsewhere, and a treasurer's report for the fiscal year ending June 30, 1895.

Report of the treasurer of New Hampshire Station, 1894 (*New Hampshire Sta. Rpt. 1894, pp. 172, 173*).—A financial statement for the fiscal year ending June 30, 1894.

Annual Report of New Hampshire Station, 1895 (*New Hampshire Sta. Bul. 31, pp. 24, fig. 6*).—This consists of a brief general review of the work of the year, a financial report for the fiscal year ending June 30, 1895, and brief reports from the departments of chemistry, meteorology, and agricultural engineering, entomology, and bacteriology, some of which are referred to elsewhere.

Seventh Annual Report of New York Cornell Station, 1894 (*New York Cornell Sta. Rpt. 1894, pp. 6–24; Appen., pp. 740*).—This includes brief reports by the director and heads of departments upon the work of the year, reprints of bulletins with indexes of illustrations and text, and a detailed financial report for the fiscal year ending June 30, 1894.

Fourteenth Annual Report of Ohio Station, 1895 (*Ohio Sta. Rpt. 1895, pp. XLIII*).—This includes a brief report by the secretary of the board of control; report of the treasurer for the fiscal year ending June 30, 1895; report of the director on the season and crops, work of the station and substations, and publications issued; a list of donations made to the station; and reports of heads of station departments, including some work mentioned elsewhere.

Seventh Annual Report of South Dakota Station, 1894 (*South Dakota Sta. Rpt. 1894, pp. 34*).—A financial report is given for the fiscal year ending June 30, 1894, and the director and heads of departments summarize briefly the work performed during the year. Some experiments are given in detail, and are elsewhere reported. The bulletins issued during the fiscal year are bound with the report.

Eighth Annual Report of South Dakota Station, 1895 (*South Dakota Sta. Rpt. 1895, pp. 22*).—A financial report for the fiscal year ending June 30, 1895, is given, as reported to this Department, upon the prescribed schedules; and the president briefly summarizes the work of the year and outlines future experiments. The bulletins for the fiscal year are bound with the Annual Report.

Eighth Annual Report of Texas Station, 1895 (*Texas Sta. Rpt. 1895, pp. 745–786*).—Brief reports upon condition of station work by the director and heads of departments; financial statement for the fiscal year ending June 30, 1895; synopses of all bulletins issued by the station; and index to the publications of 1894 and 1895.

Reports of director and treasurer of Wisconsin Station, 1894 (*Wisconsin Sta. Rpt. 1894, pp. 1–4, 384*).—Brief remarks by the director upon the work of the station, a list of the station publications available for distribution, and a financial statement for the fiscal year ending June 30, 1894.

Fifth Annual Report of Wyoming Station, 1895 (*Wyoming Sta. Rpt. 1895, pp. 34; and Appen., pp. 167*).—This includes brief reports upon condition of station and station work by the director, heads of departments, and superintendents of substations; treasurer's report for the fiscal year ending June 30, 1895; and reprints of press bulletins. The appendix contains reprints of Bulletins 21–26.

Agricultural Station of the Island of Mauritius, report of the work of 1895, M. P. BONAME (*Ann. Sci. Agron., 2 (1896), No. 2, pp. 265–320*).—This article embraces work done on the following subjects: Meteorology; experiments with different manures on sugar cane; the utilization of molasses for food for man and animals, as a manure, as fuel, in the manufacture of salts (K_2CO_3), and of alcohol; and potato culture, including varieties, planting of whole and cut tubers, and planting with and without manure.

The agricultural experiment station for the Province of Posen, M. GERLACH (*Chem. Ztg., 20 (1896), No. 57, pp. 556–558, figs. 11*).—An illustrated description of the buildings and laboratories, laboratory equipment, etc.

What the country is doing for the farmer, W. S. HARWOOD (*North Amer. Rev., 1896, Nov., pp. 527–536*).

Variety tests in the experiment stations (*Garden and Forest, 9 (1896), No. 456, p. 461*).—Editorial notes on the value of variety tests.

Miscellaneous agricultural topics (*North Carolina Sta. Bul. 123, pp. 372–383*).—Reprints of the press bulletins of the station issued in August, October, and November, 1895. Some of the more important topics discussed in a popular way are harvesting and threshing cowpeas by machinery, feeding calves, grasses for hay and comparative values of hay, rust in small grains, onion growing, milk testing, comparative draft upon soil of wheat and oats, and notes on insect pests of shade trees, lesser locust, harlequin bug, and cabbage maggot.

NOTES.

IDAHO STATION.—The foundation is being laid for a small propagating house.

MICHIGAN STATION.—C. E. Marshall, formerly instructor in bacteriology at the University of Michigan, has been appointed bacteriologist to the station.

NORTH CAROLINA STATION.—The station no longer coöperates with the U. S. Weather Bureau in the conduct of the North Carolina section of the Climate and Crop Service of the Weather Bureau.

NORTH DAKOTA COLLEGE AND STATION.—Mr. J. A. Jeffery, a graduate of the University of Wisconsin, has been elected assistant in agriculture in the college and station.

PENNSYLVANIA STATION.—M. S. McDowell has resigned his position as assistant chemist, and Mr. C. A. Brown, B. S., has been appointed to succeed him. Mr. C. W. Norris, B. S., has received a temporary appointment as assistant chemist to the station.

By action of the board of trustees, on recommendation of the director, the creamery, which had been heretofore operated by the experiment station, has been placed under the control of the school of agriculture, but will still be available for experimental work.

UTAH STATION.—A poultry department has been added, and experiments with laying hens have been commenced. A building has been erected containing 10 separate pens with outside runs.

PERSONAL MENTION.—Baron Ferdinand von Mueller, the well-known Australian botanist, died October 9, 1896. A portrait and review of his life is given in *Gard. Chron., ser. 3, 20 (1896) No. 512, pp. 464–466.*

Dr. Henry Frimen, one of the authors of Bently & Frimen's "Illustrated Medicinal Plants," died October 16, 1896. At the time of his death he was engaged on his handbook of the Flora of Ceylon.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1–11; Vol. VIII, Nos. 1–3.

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THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beattie

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII No. 5

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
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With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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EXPERIMENT STATION RECORD.

VOL. VIII. NO. 5.

The European experiment stations have, as a rule, a more simple organization than our own, and they have greater singleness of aim in their work. Many of them have only the means and facilities for work in one or two lines, and even where it would otherwise be possible to extend their operations they have chosen to remain at work on a few problems. As means increase and the work develops, there is a tendency to increase the scope of their undertakings. This is illustrated at such places as Halle, where Professor Maercker has built up a large station with ample resources and is extending his work in a number of different directions. In many cases we find agricultural researches being carried on at universities by different professors as a part of their work, without a distinct station organization.

The facilities and the methods employed in European stations indicate relatively great thoroughness in their work. A scientific atmosphere seems to pervade these places. The apparatus and other facilities are ample for the line of work in hand, while in other respects the laboratories may be poorly furnished. Little details of manipulation are carefully attended to. In some instances this spirit may be carried to an excess and become finical.

There seems to be relatively great patience and perseverance in the European stations in carrying out lines of work once determined upon as useful and important. It is not expected that important results will be quickly reached, and where much that is useful has already been attained, this only strengthens the determination to persist in that line of work. This is well illustrated by the Bernburg Station. Hellriegel is dead, but Dr. Wilfarth and his associates are continuing the investigations in the old lines with as much courage and hopefulness as ever.

Without doubt, much greater stress is laid on the keeping of systematic and detailed records of work than is the case in our own stations. Rothamsted, Halle, and Poppelsdorf are notable examples of carefulness in this direction. At the last-named place the records of field experiments which are first made by individual observers in small notebooks are carefully copied out and systematized by a clerk who has a doctor's degree as the result of pursuing university courses in agricultural science, and thus is able to critically survey the work and

detect errors in notation or computation. Great care is also taken by many of the European stations to carefully preserve specimens of plants, feeding stuffs, and other materials which have been the subject of experimentation, and to collect specimens which may be useful in connection with the work which the station is doing. Thus at Tharand, Nobbe has for many years made collections of the seeds of useful and noxious plants; at Grignon, Dehérain has preserved specimens of the plants which he has analyzed; and at Rothamsted, Lawes and Gilbert have taken numerous samples of the crops grown on their experimental plats.

There seems to be a greater tendency than formerly among the European stations to enter upon field experiments. This has been increased as the result of the visits which leaders in agricultural science have made among the experiment stations in this country. The necessity of applying the principles learned in the laboratory under field conditions is better appreciated than it once was. There is also a feeling that by careful field work light may be thrown on problems the solution of which has not yet been obtained by pot experiments or other laboratory methods. The expansion of field work is, however, being made carefully and cautiously, and a clear distinction is made between experimental plats and fields of demonstration. The former are still kept within strict limits as to size and other conditions and data on a number of different points are carefully collected. There is, moreover, a combination of field and laboratory work which is often lacking in our stations. Pot experiments and plat experiments go on side by side and analyses of various kinds are made at the same time in the laboratories. Professor Wohltmann's work at Poppelsdorf is a good illustration of this. His experiment field is level, has even soil, and is carefully fenced in. Mechanical and chemical analyses of the soil are made from time to time. Phenological and meteorological observations are recorded. There are thermometers on the plats at the surface and at different depths. A record of the sunshine is made, as well as of rainfall and temperature. The products from the different plats are analyzed and, in the case of vegetables, are also subjected to cooking and eating tests.

European workers have some of the same difficulties to contend with that our workers in field experimenting have. The past summer drought and storm ruined many promising experiments in Europe. Their variety tests are also invalidated in some cases by misinformation regarding the names of varieties.

In thinking about the European stations it is well to bear in mind that very many of them have been organized primarily for control of fertilizers or seeds, and oftentimes do little or no original work. Some of the stations which have done the most for agricultural science have obtained a large amount of funds devoted to original research from the

proceeds of fees for control work. This routine work, however, often absorbs so much of the energy of station workers that they are not able to do much else. Very many European investigators would hail with delight relief from this work, provided there came with it such abundant funds as our stations have for original research. The system of voluntary control of fertilizers and seeds so long practiced in Europe is now being subjected to considerable criticism and in some quarters at least there is a disposition to seek the enactment of laws patterned after our fertilizer statutes.

The apparatus and mechanical appliances of the European stations oftentimes seem to be clumsy and unnecessarily complicated. It is believed that our workers have the advantage in inventiveness and in the opportunity to secure the aid of quick-witted mechanicians. If we would only give more attention to improvement of appliances for experimenting, we ought before long to outstrip our European colleagues in this line of endeavor.

European station officers express much surprise at the number and mass of our station publications. While some of them are inclined to take a severely critical attitude regarding these documents, those men who have the broadest outlook and who understand most perfectly the conditions of our work realize that our stations are accomplishing a great educational work for our farmers. They wish that we would be a little more orderly in our method of publication and distinguish more clearly between popular and scientific publications, but they appreciate the fact that we are bringing agricultural science home to the farmer as is done nowhere else in the world. They greatly deplore the irregularity of the publication of results of European investigations and the scattering of these reports in numerous and often obscure publications. Many European station workers evidently take a great interest in what is being done in the American stations. They follow up the reports of our work, especially as reported in the Experiment Station Record, speak discriminatingly of our methods and results, and have a high regard for the good work which has been accomplished here.

The lack of a definite system of publication of investigations, especially in popular form, is in a measure compensated by the close relations which many of the European stations hold to farmers' organizations. Agricultural societies, as well as individual farmers, seek the aid of the stations with reference to the purchase of pure seeds, fertilizers, and feeding stuffs and take their advice regarding the introductions of new crops and improved methods of agriculture.

Oral explanations of the station work are made at numerous farmers' meetings either by station experts or by officers appointed by the Government to go from place to place for this purpose. Fields of demonstration on which the results of station investigations are practically shown and made to conform to local conditions are increasing in

number and playing a greater part in the station enterprise abroad. Without doubt the voluntary association of numerous farmers with the experiment-station officers in plans for the repression of fraud in commercial transactions involving agricultural materials has been productive of great good to all concerned. The stations have thus secured the active support of the landed proprietors and other persons carrying on the more important agricultural enterprises. A considerable number of men having large agricultural interests have received more or less special training in agricultural science at the agricultural schools and the universities offering agricultural courses. They are thus enabled to appreciate the value of thorough researches at the stations and to give them efficient aid in perfecting legislation contributing to the success of the stations and in formulating regulations for the conduct of control work and other operations directly affecting the farmers. The voluntary system of control of seeds, fertilizers, and feeding stuffs, while it has certain difficulties which seem to hinder its application on a wide scale, has brought the stations into the most intimate relations with both the farmers purchasing such materials and the dealers selling them. The wise and just leadership which the stations have had in this enterprise has raised them to a high position in the confidence and esteem of practical men.

DAIRY WORK AT THE EXPERIMENT STATIONS.[1]

E. W. ALLEN, Ph. D.,
Assistant Director, Office of Experiment Stations.

Work in dairying and dairy farming has formed a more or less prominent part of the work of several of the experiment stations almost from the beginning. The increasing interest in dairying has led one station after another to take up this line of work, until now it is carried on at about half the stations, being a rather prominent feature in at least ten of them. Perhaps in no other line has the work been of greater practical value or reflected more credit on the stations as a whole. It has been instrumental in improving the character of the stock and the quality of the product, and in making the enterprise more profitable. Some of the more striking results of station work have been the rapid methods for testing milk, the application of the relative-value plan in paying for milk, simple tests of the acidity of ripening cream, a material advancement of practical information along the line of dairy bacteriology, the use of pure cultures in butter making, cleanliness of the stable, and in the handling of milk in relation to the keeping of milk and qualities of the butter, sterilizing and pasteurizing of milk, the effect of food on the qualities of the product, the economy of various coarse and concentrated feeding stuffs, more exact knowledge of the processes of cheese making, and the variation in the composition of dairy products in general. The stations have aided in developing the dairy industry in many States and in the establishment of coöperative creameries, while in others they have just commenced the work. A large amount of pioneer work has been done, and many of the simpler practical problems have been settled.

While in several cases the work is gradually assuming a more technical and scientific character, in many cases, notably where the work is new, the idea is apparently to follow quite largely what is believed to be the popular demand for severely practical work. This we infer from visits to the stations and a study of their published work. It frequently consists in establishing a dairy herd of considerable

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[1] This paper was originally prepared for presentation at the recent convention of the Association of American Agricultural Colleges and Experiment Stations, but was crowded off the programme by the press of routine business. Inasmuch as it contains reasonable criticisms of the work of our stations in dairying, together with pertinent suggestions regarding the further development of investigations in this line, its publication by the Department is deemed advisable.—ED

proportions and running a coöperative or private creamery. The chief object is to illustrate the ordinary operations of dairy and creamery management, and to develop the industry in the State. The work is on a commercial scale, and, in accordance with the object, is purely practical. The whole effort is to make a good, uniform product, and market it at a price which will give a good showing on the right side of the ledger. In the nature of the case, the conditions are opposed to experimental work, and often render such work well-nigh impracticable. The time and energies of the station dairymen are expended in attending to the ordinary operations of the dairy and in preventing a financial loss. Any experimental work done is purely incidental, and, indeed, not infrequently the only experimental feature about the work is that dairying is an experiment in the State.

The station has little to publish beyond the financial statement, and possibly the data showing the efficiency of the creaming and churning operations. On the whole, it is very doubtful if the results of such work are very far reaching, and they will not justify running the station dairy along such commercial lines, certainly after the matter has passed beyond an experimental stage. If the conditions are such as to warrant the station in running a commercial creamery, it should not be expected to maintain a large herd of cows to furnish the milk for that purpose. The cases are comparatively few where sufficient milk may not be obtained, even if not at paying prices, from the farmers of the neighborhood or the college herd. And where this is not possible and there is a lack of sufficient interest on the part of individuals or communities to coöperate with the station in such an enterprise, it is quite doubtful whether the station, with its limited means and the many demands upon it, does wisely to shoulder the whole burden and undertake to establish and maintain a creamery as an example. There are already such examples of successful private and coöperative creameries in a majority of the States.

Generally, it is believed, work of more far-reaching influence and more permanent value can be done by coöperating, and by experimental work in the station dairy. The ideal station dairy should be in effect a dairy laboratory, where all the operations in the line of dairying to be studied can be carried out on a sufficiently large scale to give the results a practical interest, or where special studies may be made. It should not be required to be self-supporting, for it will be run on an experimental scale, and there may be losses, for reasons that are obvious.

For such dairy work and feeding experiments connected with it a large herd is not needed, and is, in fact, a load on the station rather than a convenience. There are numerous examples of this and of its general effect on the work of the station in other lines. The herd, consisting frequently of from 20 to 50 cows, and in some cases more, must be fed, and as a result the farm is run principally as a forage farm in which the experimental features are in the minority. The energies

of the agriculturist are largely expended in looking after these practical farming operations and managing the herd; the labor bills amount to several thousand dollars, and the returns in some cases scarcely cover the farm labor. Such an enterprise is directly opposed to the best interests of the legitimate experimental work of the station, and little is accomplished of a practical nature which could not have been ascertained equally well with a small herd. The object commonly sought is to make a record of the herd, showing the milk yield, and the composite test of the milk—frequently the mixed milk of the herd. Herd records undoubtedly have a value, and will naturally be kept by a station having any number of cows; but the maintenance of a large herd for this purpose solely, or even mainly, is certainly questionable, and the more so unless quite full data are kept. The observations should be taken for individual cows, and should be so kept and discussed as to furnish some general deductions.

The station may properly exert every influence to induce farmers to weed out their herds and keep fewer and better cows. To illustrate this forcibly by herd records an accurate financial account is necessary. Such data as the amount and cost of grain eaten by the individual cows, the approximate amount and cost of coarse fodder, the yield, composition, and value of the milk, and the probable yields of butter or cheese, are necessary factors for discussing the record. If the station has a herd composed entirely of good cows the application of the record is less forceful. Often greater interest can be aroused by making trials at private dairy farms where the herd is of mixed quality.

Unless there be some specific object in view, which does not always appear to be the case, there is little of public interest to be gained by a lengthy test of the herd, and the station can not afford to make it more than an incidental part of its dairy work.

It is believed to be entirely feasible, by proper planning ahead, to so vary the conditions of feed, general treatment, and handling or use of the milk of a small station herd, that data of scientific value, which will have a bearing on some point of interest in dairying, may be secured from the herd during the greater part of the time when it is not actually under experiment. Some of this it will be desirable to publish, but much of it will be unsuited to immediate publication. The latter should be written up and discussed under appropriate heads in the permanent records, and subsequently added to until some safe deductions are possible.

It is believed to be a mistake for a station to confine itself to the purely practical or commercial side of dairying or to undertake so much work of this character that it will not be able to do some work of an investigational nature. There should be from the first a combination of the purely practical work with investigations along scientific lines, and as time advances it will be possible gradually to develop this investigational side. We must recognize this as the line along which

advancement is to be made, and if this plan is not followed the station will before long find itself threshing over old straw and reaching the limit of its usefulness in this field of inquiry. That it is possible to make this combination of work is satisfactorily shown by the history of dairy investigation at a number of stations. Starting with work which was largely practical, but included from the first some more advanced studies, there has been a gradual change in the character of the work, without at any time losing sight of its ultimate practical application, until the investigations have, from a scientific standpoint, been of interest and application far beyond the boundaries of the States in which they were undertaken, and have been most valuable contributions to dairy science and practice. It is work of this character which is of the most far reaching and permanent value, and some of it, at least, should be encouraged by every station which makes dairying a feature. To load down the agriculturist or dairyman with the routine work of running a large dairy or creamery is unjust to the worker and a short-sighted policy for the station.

It is well to remember, too, that a great deal of the work already done is entirely applicable to the conditions of other States, and has already passed beyond a point where it needs further corroboration. An extended series of experiments repeating such work is an expensive way for a station to get these established facts before its farmers and dairymen. Much good work has been done and corroborated at other stations and become a part of our science of dairying. It seems extremely desirable that in this, as in other lines, certain matters should be recognized as settled, and that instead of multiplying still further the experiments on such points, even under the guise of instructing the farmers, the facts should be accepted and presented in a plain, concise manner.

An example of such repetition is the comparison under ordinary conditions of the creaming of milk in shallow pans, in deep setting, and by separator. Experiments galore on this question have already been made in many States and under a variety of conditions, and we have only to look into the European text-books on dairying to find that it has been a subject for experiment for many years. As an illustration, such work can hardly be held to be worth the while, as comparatively few farmers visit the station and see the work in progress. For this purpose a few simple tests of the efficiency of creaming, as practiced by typical farmers in a community, would, it is believed, be more convincing and bring the matter home more closely to the farmers of that community.

The case is quite different where the specific effect is to be studied of particular feeding stuffs or rations, as will be mentioned later.

Another instance of repetition is the testing of different kinds and sizes of separators. This has constituted a prominent part of the dairy work at several stations for a number of years, until now the trials with

the more common forms are numbered by hundreds. Many of these tests have been made in connection with dairy-school work. Considering that under these conditions the machines are run by inexperienced persons for practice, although under the general supervision of an instructor, it can hardly be expected that very reliable results will be secured, and such work can certainly not be regarded as of very high character for an experiment station. The dairy school is usually of short duration and its function is essentially educational. Results obtained incidentally under such circumstances as to the efficiency of dairy apparatus, can hardly be said to constitute a fair trial of the apparatus or to carry any considerable amount of conviction. They are usually not satisfactory to the manufacturers aside from those whose machines have made the best showings, and they involve the stations in altercations and submit them to charges of doing unreliable work, which they may have difficulty in refuting. As far as the published work is concerned, it seems far better to divorce entirely the station work in this line, as in others, from the instructional work of the college. In regard to the testing of separators and other dairy apparatus, it may be questioned whether the time has not come when this may be discontinued, as far as the common makes and forms are concerned, and limited to new forms or improvements which make their appearance. Beyond doubt the work which has been done has been extremely useful in enabling the stations to give advice as to the kinds and sizes of separators, and in keeping out of the market or limiting the sale of inferior makes. The relative merits of the different kinds have been quite generally determined under a variety of conditions, and the data already accumulated have been compiled and summarized, making it possible for any station to intelligently give advice in the selection of apparatus as called upon. It has been apparent for some time that the method of handling the machine influences the results, and some recent work has brought out marked differences between individual separators of the same make and model. Moreover, the machines are undergoing modification from time to time, and new forms make their appearance, which give the figures obtained only a transient comparative value.

For the more advanced experimental work, at least, the coöperation of the agriculturist or dairyman with other members of the station staff is very desirable, and indeed almost essential to thorough work. This is too often overlooked, and we find the agriculturist or dairyman carrying on experiments without the aid or coöperation of the chemist or bacteriologist. This frequently accounts for deficiencies in the work, and lays it open to criticism, for thorough as may have been the training of the agriculturist or dairyman, he can hardly expect to carry on himself the chemical analysis necessary to exact work, and it is expecting too much of the Babcock test to rely upon it as the sole aid in such experiments.

There is often, unfortunately, what appears to be a jealousy among the station workers in different lines which prevents their joining in carrying on investigations. One fears that by accepting the coöperation of another he will sacrifice some of his dignity or credit for the work. But, on the contrary, a thorough investigation, worked up from the different sides, is a greater credit to each one participating in it, and contributes more to the reputation of the workers and the station than numbers of one-sided experiments of indifferent value. Working together, the dairyman, chemist, and bacteriologist can conduct experiments which would be impossible for either one working single-handed, and the results need be none the less practical in their application.

It is believed also that there is opportunity for much to be done through coöperation between stations located in the same region and where the same general conditions prevail. Coöperative feeding experiments with cows have been successfully carried on in Denmark for a series of years, the coöperators being the owners of large estates, and the whole experiment being under a general direction. There are many questions which might with advantage be studied by a number of stations in unison and on a common plan. The results would in the end be more conclusive and of wider application, and the tendency would be toward more thorough work. As a matter of fact, the station work in dairying, as in other lines, is frequently open to the criticism of having too local a cast, and this is, of course, one of the tendencies of purely practical work. We have whole groups of States which are no larger in area than some single States, and aside from purely local questions, results obtained in one locality will generally be applicable in the localities immediately adjoining. The much discussed question of the applicability to our conditions of Wolff's standard for cows, and its physiological accuracy, suggests itself as a theme for such coöperative work.

As to the character of the work of a station in general, this will naturally depend to a considerable extent on the status of dairying in the State and its probable development. Including dairy farming under the general scope of this paper, there is still room in most States, especially those where dairying is comparatively new, for work on forage crops adapted to dairy farms, systems of rotation for this purpose, the supplying of green crops, the storage of green food, and the value of local waste products. In the Southern States, where dairying has only recently been taken up, the problems of this sort are numerous. The value of corn stover for these States has been only imperfectly studied, under a few conditions, and with somewhat conflicting results. Here also there is opportunity for raising the standard of the product of the farm dairy. The proper use of cotton seed and cotton-seed meal is but imperfectly understood, and its effect on the butter when fed in different ways and differently prepared has not been sufficiently studied. The method of butter making commonly practiced in the South, of

allowing the milk to sour and then churning the whole milk, may be studied from all sides, in comparison with improved methods, and the differences brought out as to the recovery of the butter fat, the composition of the butter, its qualities, grade, marketability, and behavior on keeping. The improvement of dairy stock and its management should also prove a profitable line of work, and in this, coöperation with leading farmers in testing the milk of their cows and studying their rations suggests itself.

There is thus far a deficiency of exact work to show the relation between the food and the creaming of the milk, the churning of the cream, and the general qualities of the butter. As a rule, feeding experiments with cows stop with the yield of milk and its average composition. Enough work has been done to show that certain feeding stuffs have a marked effect on the butter. This is noticeably true of cotton seed and cotton-seed meal, and we have a few experiments indicating the superior effect of steamed cotton seed. Systematic study along these lines is to be desired, for just such knowledge is of importance in fixing the real value of different coarse and concentrated foods for butter making and in indicating the best dairy foods to grow and to purchase.

A few years ago Prof. Adolf Mayer reported experiments on the effects of various feeding stuffs on the volatile fatty acids, the hardness, etc., of butter, and gave a list of coarse and concentrated feeding stuffs arranged in the order in which their effects were apparent. On the basis of this work he advanced the hypothesis that rations rich in carbohydrates have the effect of increasing the volatile fatty acids. This interesting work has never been corroborated or carried further. There is a broad field for study of the specific effect of the food or its constituents on the milk and butter, and such work would form an interesting contribution to the science of the subject and to our knowledge of the physiological function of milk secretion.

Furthermore, the question as to the best ration for dairy cows, as far as composition is concerned, is a very live subject. The question is not so much whether the percentage of fat in the milk can be increased by feeding, but relates to the amount of protein and other nutrients which in the long run will give the best results, as far as the yield of milk and butter and the health of the cow are concerned. There has been considerable work upon this with varying results; and the study of the practice of intelligent dairy farmers in different parts of the country has developed the fact that they have widely different opinions as to the amount of nutrients, as expressed in the amounts of feeding stuffs, which the cow can use to the best advantage. The experiments have been of far too short duration to settle this question. We have learned, for instance, that by feeding rations rich in protein we can crowd the cow to her utmost capacity, for a time at least, but how long this can be kept up and what the final effect will be on the health of the cow

has not been demonstrated. Unquestionably the individuality of the animal is an important consideration; but experiments with a number of animals continued through a series of years would contribute materially to our information on this point, especially if such experiments could be carried on at a number of stations. It would require time, but such work would in the end be of the greatest practical interest. The matter is far from clear, either from the scientific or the practical standpoint.

Dairy bacteriology presents a most promising field for investigation, and has already cleared up many points as to the cause of good and poor butter and cheese and suggested many improvements and safeguards in the handling of milk. The proper management of the ripening of cream, the use of pure cultures and of pasteurized cream, the numerous sources of contamination, the relation between the bacterial flora of the foods and the quality of the product, and the causes of various so-called "milk faults," with remedies for the same, are questions upon which the bacteriologist can profitably devote much study and give most useful information. The importance of bacteriology in dairying has only just commenced to be appreciated, and we have only made a beginning in this direction. For a station where dairying is made a prominent feature the bacteriological side can not be overlooked. It compares in importance with chemistry and animal nutrition. It has contributed some of the greatest advances in dairying of modern times, and the problems for its solution touch every stage of dairy work from milking to the finished product.

It has recently been claimed that the incompleteness of churning sweet cream may be overcome by making the cream acid with dilute hydrochloric acid. Experiments have been made at several German experiment stations and creameries with quite satisfactory results. A rather shorter time was required for churning, and the butter was usually quite normal in taste and appearance, though lacking in aroma. The results were, on the whole, quite promising, and it was claimed that the butter would keep longer than sweet-cream butter, but the matter has hardly passed beyond an experimental stage. Taken in connection with Dr. de Schweinitz's proposition to use the products of the desirable bacteria of ripening cream instead of the cultures themselves, the use of an artificial acid and aroma in sweet cream suggests itself as possibly within the bounds of practicability and a not altogether visionary theme for experiment.

The breeding of cows especially adapted to local conditions, the sanitary arrangements of stables, ventilation, heating, cleanliness, and allied questions may, in many cases, be studied incidentally.

In addition to the regular dairy work, and often in connection with it, there is opportunity for special studies on milk and dairy products. We have, for instance, very little exact chemical knowledge as to the constituents of milk, especially the nitrogenous constituents. The

exact nature of these constituents and their chemical and physical properties as they exist in the milk, the way in which they vary during the period of lactation and during successive periods of lactation, the changes they undergo in souring and curdling, in boiling, and in making into cheese, the reaction of milk, the differences between the constituents of human milk and cows' milk, the chemistry of the ripening of cream and of cheese, and the nature of the aroma and flavor of butter are questions of much scientific interest. The work on these subjects is fragmentary, and it is possible that much of it might be negatived by investigation with improved methods and apparatus. Although of difficult nature, it is well worthy the efforts of the chemist who can find time for some advanced scientific work.

Whatever the particular line of dairy work undertaken by the station, it is well to remember that the operations of experimenting, even along the most practical lines, are essentially different in details from those followed by the farmer, and require close supervision and attention to the minor details. Such work can not be left to students or ordinary laborers unless a close oversight is maintained. No matter how simple the work the results should be obtained in a scientific manner and not be a matter of inference. It is in this respect chiefly that the simpler experiments differ from the experience of the farmer. The station should expect to keep some distance in advance of the ordinary practice of the community, for it should lead rather than follow. And the station, which, from the nature of the conditions, feels the necessity of doing pioneer work, should not make the mistake of undertaking to run a model creamery or dairy farm for illustration or of going over ground which has been thoroughly traversed in other States with results which are quite generally applicable. It should endeavor rather to select those special themes which are suggested by its local conditions and which have not been settled by previous study. Real progress comes only in this way. Let what is done be thoroughly done and with a view to the real status of knowledge on the question. Then the work of one station will supplement that of others and the science and practice of dairying will be slowly but surely advanced.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The chemical nature of diastase, T. B. OSBORNE and G. F. CAMPBELL (*Connecticut State Sta. Rpt. 1895, pp. 233–238*).—A continuation of studies reported in the Annual Report of the Station for 1894 (E. S. R., 7, p. 182). "As yet no preparations of diastase have been realized more active than those there described. The results given in the former paper, however, have been confirmed, and details of the process for obtaining highly active diastase have been determined more exactly."

After studying more thoroughly the conditions under which diastase may be separated from the other malt proteids, considerable quantities of diastase were prepared from a malt extract rich in diastase obtained from the Maltine Manufacturing Company. All efforts to get a diastase of greater power than 300 by fractional precipitation with alcohol failed. Several hundred tests were made of the influence of various conditions on the diastatic action, but "in the majority of instances no such uniform results were attainable as would lead to safe conclusions in regard to the circumstances that insure a high degree of diastatic activity."

"From our experience in testing these preparations it would seem that the purer the diastase is made, the more sensitive it is to external conditions, and that the method of testing the purity of the ferment by its maltose-producing power thus becomes of uncertain value and perhaps fails to furnish a safe criterion of the purity of the enzym. That the proteid is not the only factor involved in the amylolytic action of diastase is indicated by the great influence on its activity that often accompanies the addition of various substances to its solution. In view of these facts, it is not at all improbable that in thus attempting to purify diastase we remove some substance that favors, or is essential to its action, and that we may have in hand what may be properly termed the enzym itself, which is feeble in its operation through the absence or deficiency of some accessory substance. Thus the addition of sodium chlorid in many cases increases the diastatic action several fold. That the albumin is an essential factor in diastatic action could not be positively proved, but the results of further experience have tended to strengthen this belief. Of all the preparations that we have made, none from which albumin was absent showed amylolytic power, and those containing the most albumin were the most active. It was always possible to roughly judge of the diastatic power of a preparation by heating a portion of its solution to 65° C. and observing the amount of coagulum formed.

"The fact that active diastase was obtained only from solutions whose alcohol

content lies between 50 and 60 per cent, may, we think, be regarded as probable evidence that the enzym is not something carried down mechanically with the proteid."

The proteids of malt, T. B. OSBORNE and G. F. CAMPBELL (*Connecticut State Sta. Rpt. 1895, pp. 239–254*).—The details are given of an extended investigation of this subject, including the derivation of the preparations, their elementary composition, characteristics, etc. The main points of especial interest are given in a summary, from which the following is taken:

"In the malt used in this investigation we have found:

"(1) Bynedestin,[1] readily soluble in very dilute salt solution, therefore largely passing into the aqueous extracts because of the soluble salts of the seed. This globulin contains 2 per cent more carbon and 3 per cent less nitrogen than edestin, the globulin of barley, and is much more soluble in very dilute salt solutions than edestin.

"The composition of this globulin, as shown by the average of 11 analyses, is:

Bynedestin.

	Per cent.
Carbon	53.19
Hydrogen	6.69
Nitrogen	15.68
Sulphur	1.25
Oxygen	23.19
	100.00

"Bynedestin, dissolved in 10 per cent sodium chlorid solution, gives a turbidity at 65° and a flocculent coagulum at 84°, but, even after heating for some time at 100°, the coagulation is far from complete.

"This proteid is not precipitated by saturating its solutions with sodium chlorid, and but partly precipitated by saturating with magnesium sulphate.

"(2) Leucosin, an albumin, identical in composition and properties with the leucosin found in wheat, rye, and barley. The composition of this proteid was found to be:

Malt albumin, leucosin.

	Per cent.
Carbon	53.07
Hydrogen	6.72
Nitrogen	16.71
Sulphur, Oxygen	23.50
	100.00

"Leucosin is intimately associated with diastase.[2] Heated to 50°, solutions of this proteid become turbid, and at 58° a flocculent coagulum occurs. Coagulation, however, is incomplete unless the solution is heated for some time and the temperature raised to about 70°. Saturation with sodium chlorid or with magnesium sulphate partly precipitates leucosin.

"(3) A protoproteose readily precipitated from aqueous solution by adding an equal weight of alcohol. No preparations of this body were obtained free from albumin. Its composition is nearly the same as that of leucosin, since preparations

[1] From βυνη, malt, and εδεστὸς, edible.

[2] Conn. State Sta. Rpts. 1894, pp. 202, 204; 1895, p. 238.

containing from 90 to 50 per cent of it, together with from 10 to 50 per cent of leucosin, are not distinguishable by analysis.

"(4) A protoproteose less readily precipitated by alcohol than the preceding, and of a different composition, as shown by the following figures:

Malt protoproteose.

	Per cent.
Carbon	50.63
Hydrogen	6.67
Nitrogen	16.69
Sulphur, Oxygen	26.01
	100.00

"That this is not an impure preparation of the preceding, is indicated by the fact that the amount of nitrogen is alike in both, while the carbon differs by 2 per cent. This difference would probably not be caused by non-proteid impurities. It is possible that the deuteroproteose, next to be described, may not have been completely separated by the process employed.

"(5) A deuteroproteose which could not be separated from non-proteid impurities.

"(6) A heteroproteose in extremely small amount.

"(7) Bynin, a proteid insoluble in water and saline solutions, but readily soluble in dilute alcohol. About 1.25 per cent of this proteid was obtained from the malt, having the following composition:

Bynin.

	Per cent.
Carbon	55.03
Hydrogen	6.67
Nitrogen	16.26
Sulphur	0.84
Oxygen	21.20
	100.00

"(8) A proteid insoluble in water, in salt solution, and in alcohol, amounting to 3.80 per cent. The composition and properties of this proteid we have been unable to determine.

"Assuming 21 per cent of the total nitrogen of the malt to exist in non-proteid bodies, and admitting the malt proteids to contain on the average 16.3 per cent of nitrogen, we have, in the malt investigated, a total of 7.84 per cent of proteids.

	Per cent.
Proteid, insoluble in salt solution and in alcohol	3.80
Bynin, soluble in dilute alcohol	1.25
Bynedestin, leucosin, and proteoses soluble in water and salt solution:	
Coagulable	1.50
Uncoagulable	1.29
Total proteids	7.84

"The results of this study show: That, in germination, the proteids of barley undergo extensive changes without acquiring, or before acquiring, the properties of proteoses; that hordein disappears and an alcohol-soluble proteid of entirely different composition takes its place; that edestin also disappears and a new globulin is formed, very different both in composition and properties. The albumin, on the other hand, appears to be unchanged in its characters, but its quantity is increased. It is to be noted also that hordein and edestin are both replaced by proteids much richer in carbon and poorer in nitrogen."

The proteids of the potato, T. B. OSBORNE and G. F. CAMPBELL (*Connecticut State Sta. Rpt. 1895, pp. 255-261*).—Brief reference is made to previous work on this subject by other investigators. The details of the manipulation of the pulp and isolation of the proteids are described. In general, these methods were similar to those followed by the authors in previous investigations. The proteids were found to consist of a globulin, for which the name tuberin is proposed, and a proteose, occurring only in very small amount. The properties of the tuberin are described as follows:

"[Tuberin] is precipitated by saturating its solutions with sodium chlorid, sodium sulphate, magnesium sulphate, or ammonium sulphate. By acetic acid or nitric acid a precipitate is given readily soluble in an excess of acid even in the presence of salts. Potassium ferrocyanid gives no precipitate until acetic acid is added. Mercuric chlorid gives no precipitate, but picric acid or tannic acid throws down the globulin. With the biuret, Millon's, and the xanthoproteic tests the usual reactions are given.

"Tuberin is soluble in very dilute saline solutions, and therefore the juice of the potato contains the greater part of this proteid. By dialysis it is precipitated slowly and incompletely because of the difficulty of removing all soluble salts by this process. Like other easily soluble globulins, it readily changes to the insoluble modification, so that preparations made by dialysis are to a great extent insoluble in saline solutions. In contact with alcohol it very quickly loses its solubility.

"When dissolved in 10 per cent sodium chlorid solution, tuberin shows a somewhat variable heat-coagulation point, depending on the conditions under which it is tested. In general, a flocculent coagulum is formed on heating to 60 to 65° C. Coagulation is, however, not complete until the solutions have been heated for some time at 80° C. The composition of this globulin was found from an average of several accordant analyses to be:

Tuberin from potato.

	Per cent.
Carbon	53.61
Hydrogen	6.85
Nitrogen	16.24
Sulphur	1.25
Oxygen	22.05
	100.00

Legumin and other proteids of the pea and the vetch, T. B. OSBORNE and G. F. CAMPBELL (*Connecticut State Sta. Rpt. 1895, pp. 262-287*).—"In recent literature legumin is most commonly referred to as a substance extracted from seeds by caustic alkalies, and more or less altered by the action of the solvent; but nothing has been done, to our knowledge, to show the nature of the original proteid.

"The object of our investigation has been to examine the seeds in which legumin is said to exist, and to determine as definitely as possible the composition and character of this substance."

The literature of legumin is reviewed, and the details are given of the authors' investigations on the legumin and other proteids of the common garden pea and the common vetch. The results of these investigations are concisely summarized by the authors as follows:

"(1) So far as we have investigated, peas and vetches contain the same proteids, which are nearly if not entirely soluble in 10 per cent sodium chlorid solution.

"(2) The greater part of these proteids consists of a globulin, the legumin of Braconnot, which is readily precipitated by dialyzing its salt solutions.

"The prevalent idea that legumin is soluble only in acids and alkalies is erroneous, it having been proved, notably by Ritthausen, to be a true globulin. The composition of legumin, as shown by the average of our accordant analyses of 31 preparations obtained from the seeds of peas and vetches, is the following:

	Per cent.
Carbon	52.15
Hydrogen	6.96
Nitrogen	17.98
Sulphur	.43
Oxygen	22.48
	100.00

"Legumin is abundantly soluble in solutions containing above 5 per cent of sodium chlorid; in those containing less salt it is not so soluble, the amount held in solution decreasing as the salt content diminishes, so that it is but sparingly soluble in solutions containing less than 1 per cent of salt. By dilution with water, strong saline solutions of legumin are abundantly precipitated.

"By saturation with sodium chlorid or magnesium sulphate, its sodium chlorid solutions are not precipitated; by saturation with sodium sulphate at 25° they are not precipitated, but at higher temperatures more or less is thrown down, and by saturation with sodium sulphate at 34°, precipitation is very nearly complete. With nitric acid and Millon's and Adamkiewic's reagents it gives the usual proteid reactions.

"With strong solutions of legumin the biuret test gives a violet color at first, which on standing becomes crimson red, similar to the color produced by peptones.

"The legumin obtained by us from the vetch is not coagulated by heat nor even rendered turbid by prolonged boiling of strong solutions.

"The legumin prepared by us from the pea is partly coagulated by heating strong solutions in a boiling water bath, and sets to a firm jelly after thus heating for some time. These differences in their behavior on heating, and a greater tendency of the vetch legumin to cohere in semisolid lumps when precipitated by dialysis, are the only points of dissimilarity which a rigid comparison of preparations from the 2 seeds has revealed.

"These differences, in our opinion, are due to the substances with which the proteid is associated in the 2 seeds, for saturation of the pea extracts with sodium chlorid, before precipitating the legumin by dialysis, greatly diminished the amount of coagulum given by the pea legumin.

"(3) Besides the legumin, the pea and vetch contain another proteid in small amount, either an albumin or a globulin, soluble in extremely dilute salt solutions, and coagulated by heating its solutions to 80°. This substance we have not studied further than to make 2 preparations for analysis from the pea and 1 from the vetch. These were obtained in an insoluble form by coagulating with alcohol, so that the properties and reactions were not determined. The composition of this proteid is shown by the following average of 3 closely agreeing analyses:

Proteid of pea and vetch.

	Per cent.
Carbon	53.48
Hydrogen	6.89
Nitrogen	16.43
Sulphur	1.01
Oxygen	22.19
	100.00

"(4) In addition to the foregoing proteids, a very little proteose was found in the extracts of both these seeds.

"(5) No attempt has yet been made to determine the total quantity of proteids in these seeds, nor to study minutely the proteids that occur in them in small proportion."

Conglutin and vitellin, T. B. OSBORNE and G. F. CAMPBELL (*Connecticut State Sta. Rpt. 1895, pp. 288–301.*)—"Review of the literature relating to the plant proteids hitherto described as conglutin and vitellin, shows that the subject is in great confusion. . . .

"With the object of determining, so far as may be practicable, the true relations of the globulins found in the various seeds hitherto alleged to contain conglutin and vitellin, this investigation was undertaken." Several preparations were made of the globulin in the almond and peach kernel, and these were analyzed and compared in various ways. The indications were that "the two are identical in all respects, and there can be no doubt that they are the same substance. . . . Having thus, as we believe, established this proteid as a chemical species quite distinct from all others hitherto investigated, it is proper to restore the designation amandin given it by Proust, its discoverer, and to discard for it the names vitellin and conglutin, which are associated with many erroneous statements as to its occurrence, composition, and characters."

The composition of amandin is given as follows:

Amandin.

	From almonds.				From peach.	Average.
	1.	2.	3.	4.	5.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbon	51.41	51.49	51.18	51.36	51.04	51.30
Hydrogen	6.86	6.85	6.99	6.95	6.83	6.90
Nitrogen	19.47	19.16	19.33	19.34	19.28	19.32
Sulphur	0.39	0.44	0.48	0.45	0.44	0.44
Oxygen	21.87	22.06	22.02	21.90	22.37	22.04
	100.00	100.00	100.00	100.00	100.00	100.00

The characteristics are given at some length.

The globulins prepared from the English walnut and filbert were also found to be identical in composition and properties, and "entirely distinct from either amandin or edestin. We therefore propose the name corylin, from the generic name of the filbert, *Corylus tubulosa*, in which this proteid was first found by Dumas and Cahours."[1]

[1] Jour. prakt. Chem., 28, p. 398.

The properties of corylin are enumerated, and its composition is given as follows:

Corylin.

	From English walnuts.			From filberts.
	6.	7.	8.	9.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Carbon	50.32	50.83	50.76	50.72
Hydrogen	6.69	6.79	6.89	6.86
Nitrogen	19.09	19.05	19.06	19.17
Sulphur	23.90	0.89	23.29	0.83
Oxygen		22.44		22.42
	100.00	100.00	100.00	100.00

Previous work by Osborne[1] on the globulin of the Brazil nut, which was described by Weyl as vegetable vitellin, has shown it to be "evidently different from all others hitherto examined," and the author proposes for it the name of excelsin.

Osborne[2] also obtained from the oat kernel "a crystallized globulin very similar in composition to excelsin, but different in its reactions as well as in crystalline form. This globulin might be classed as a vitellin, and for that reason is here referred to. As yet this proteid has received no specific name, and we now propose to call it avenalin."

Proteids from the seeds of hemp, squash, and castor beans have also been described under the names of conglutin and vitellin, but Osborne[3] has shown that the seeds contain as their chief and characteristic proteid one and the same substance, and has named it edestin.

"[Edestin] has been found in a larger number of seeds than any proteid yet discovered, and is the body most commonly called vegetable vitellin. It is readily obtained pure in octahedral crystals from several seeds, and owing to this fact has been employed in physiological investigations. That it is a different substance from the proteids already described in this article appears to have been mostly overlooked."

The proteid of the cocoanut described by Chittenden[4] as phytovitellin agrees with edestin in composition, and as he obtained it partly crystallized in octahedra it probably is edestin.

Ritthausen called the principal proteid of lupine seeds conglutin. Some unfinished investigations of the authors show it to be "distinctly different in composition and properties from the proteids which we have hitherto noticed, and we take especial pleasure in confirming to it the name conglutin proposed by its veteran discoverer."

Investigations still in progress indicate that the proteid of sunflower seed is also edestin.

"We have, accordingly, at least 6 perfectly distinct proteids which have been confounded together under the names vitellin or conglutin,"

[1] Amer. Chem. Jour., 14, p. 662.

[2] Conn. State Sta. Rpts. 1890 and 1891 (E. S. R., 3, pp. 11, 766).

[3] Amer. Chem. Jour., 14, pp. 671–689.

[4] Med. Rec., 45, p. 450.

i. e., amandin, corylin, excelsin, avenalin, edestin, and conglutin. The composition and distinguishing characteristics of these proteids are brought together in a table.

The chemistry of honey, O. KÜNNMANN and A. HILGER (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), p. 211; abs. in Chem. Centbl., 1896, II, No. 9, p. 476, and Chem. Ztg., 20 (1896), No. 72, Repert., p. 229*).—The statements concerning the dextrinous bodies present in dextrorotatory honeys and the fermentation of honey by yeast are very variable. The authors have conducted extended investigations with pure yeasts and have attempted to disclose the chemical nature of the dextrin.

Fermentation experiments.—All levorotatory honeys contain only traces of dextrin, and the amounts present in the dextrorotatory forest honeys have a direct relation to this dextrorotation. If, therefore, large amounts of yeast are used with the former, inactive residues are easily obtained. Von Raumer and Mader showed that press yeast acts more strongly on the honey dextrin than beer yeast. To obtain an exact measure of the fermentative energy of various yeasts, the authors started with accurately determined amounts of a dextrin which had been isolated from dextrorotatory honeys. The artificial solutions used had the following composition: Honey dextrin 1 gm., levulose 5.5 gm., dextrose 4.5 gm., and the concentrated aqueous extract (prepared by boiling) of 10 gm. beer yeast. The solution was then made up to 100 cc. with water. The yeast extract was added for the purpose of producing a smoother fermentation. One hundred and fifty cubic centimeters of this solution was mixed with 10 gm. of yeast and fermented at 25° C. for 140 hours. The beer yeasts were previously deprived of most of the water present by squeezing in a cloth, and were carefully washed with water to remove wort.

Three beer yeasts from different sources gave slight dextrorotatory residues. Two press yeasts gave inactive residues, but as such yeasts are never pure, it was thought best to prepare a pure culture of one of the species present. This showed much less energy and left a plainly dextrorotatory residue. This proved plainly that all the previous work was inexact, and that to obtain good results all materials must be sterilized, the fermentation carried on with well-characterized, easily controlled pure cultures of yeast, and all extraneous infection avoided during the fermentation.

Wine yeasts were unable to ferment the dextrin. During a period of 16 to 20 days only 8.7 to 13.1 per cent of the dextrin present was fermented.

Beer yeasts showed more energy than wine yeasts, but only the variety Saccharomyces-Pombe was able to ferment all the dextrin, while with the others the amounts varied from 40 to 25 per cent. It was further found that only extended fermentation would remove the last portions of invert sugar.

The honey dextrin was isolated by fractional precipitation with

alcohol and was found to be identical with the diastatic achroodextrin isolated by Lintner and the achroodextrin found in beer wort by Mittelmeier. It could not be crystallized, and by the freezing method gave the molecular weight 1,962, corresponding to the formula $(C_{12}H_{20}O_{10})_6H_2O=1,962$.

Preparation of the disaccharid.—All fractions remaining from the preparation of the dextrin whose rotation did not exceed +145° were united and the disaccharid separated by precipitation with alcohol and dialysis. The dialysate gave an osazone consisting of light yellow needles, 0.32 gm. of which, dissolved in 100 cc. absolute alcohol, gave $[\alpha]$ D=+54°. The melting point was 184 to 186°. Although maltosazone has $[\alpha]$ D=+61° and a melting point of 202 to 206°, the disaccharid of honey dextrin is probably maltose.—W. H. KRUG.

Contributions to the analysis of honey, E. BECKMANN (*Ztschr. analyt. Chem., 35* (*1896*), *No. 2, p. 263; abs. in Chem. Ztg., 20* (*1896*), *No. 70, Repert., p. 221*).—König's method for the detection of glucose in honey does not always yield reliable results, as many honeys can contain from 15 to 20 per cent of starch sirup or starch dextrin without showing dextrorotation after precipitating with alcohol. The author uses acetone or methyl alcohol and finds that all, even dextrorotatory honeys, are taken up by these solvents, while a honey mixed with glucose sirup gives a copious precipitate of dextrinous substances. The reaction of such a honey with an iodin solution is also characteristic. It becomes intensely red, or even violet, while a pure honey is colored only slightly.

To detect adulteration with glucose the following method is proposed: Five cubic centimeters with a 20 per cent honey solution is mixed with 3 cc. of a 2 per cent barium hydrate solution and 17 cc. of methyl alcohol and well shaken. The presence of even slight amounts of glucose, or glucose sirup, is shown by the resulting turbidity. When a clear solution of honey can not be obtained, the polarization must be united with this test.—W. H. KRUG.

The determination of sugar in chocolate, ROCQUES (*Ann. Chim. anal. appliq., 1* (*1896*), *p. 288; abs. in Chem. Ztg., 20* (*1896*), *No. 72, Repert., p. 229*).—Fifteen grams of the powdered chocolate is heated to 40° C. with 90 cc. of water until the cocoa butter has melted, and the mixture is well stirred. Fifteen cubic centimeters of a 10 per cent basic lead acetate solution is then added, the liquid filtered, and the lead removed by adding to 70 cc. of the filtrate 30 cc. of a solution consisting of 20 cc. of a 20 per cent sodium sulphate solution and 10 cc. of glacial acetic acid. This gives a very clear filtrate, which can be easily polarized.—W. H. KRUG.

The estimation of tannin, B. WEISS (*Der Gerber, 22* (*1896*), *p. 62; abs. in Jour. Soc. Chem. Ind., 15* (*1896*), *No. 8, p. 620*).—The author finds that it is essential to use a constant weight of extract dissolved in a constant volume of water and to work at the same temperature. It is shown that hide powder which has been washed and dried as

recommended by Cerych again yields a solution which gives a turbidity with tannin when soaked in water, as though the hide fiber were converted into gelatin by the action of water at the ordinary temperature. This is prevented to some extent by treating the hide powder with an antiseptic such as lysol or mercuric chlorid.

Thirty-five grams of pure unsized filter paper is pulped in 2 liters of 2 per cent lysol solution; 100 gm. of hide powder is added and allowed to remain several hours. The mass is drained on a funnel, pressed, and treated, once with pure water, once with dilute alcohol, and once with strong alcohol. The mixed powder and paper are then allowed to dry over night and pulverized.—W. H. KRUG.

Division of chemistry of Kentucky Station, A. M. PETER (*Kentucky Sta. Rpt. 1895, pp. XI–XXV*).—Analyses are given of sorghum cane, butter, distillers' grains or dried distillery slop, sugar beets, mineral waters, saltpeter made from tobacco stems, coal, iron ore, limestone, niter earth, White Burley tobacco, tobacco stems, tobacco ashes, ash of corn stover, corundum, cider, and phosphatic fossil shells. In 4 samples of butter the fat varied from 75.15 to 82.99 per cent, and the water from 11.86 to 14.44 per cent. The sample of "dried distillers' grains" contained water 8.66 per cent, crude protein 29.94, albuminoids 28.88, fat 8.94, nitrogen-free extract 39.39, fiber 11.62, and ash 1.51. The saltpeter from tobacco stems was obtained as a by-product in the manufacture of tobacco extract. It contained from 40.92 to 45.02 per cent of potash and from 11.59 to 12.90 per cent of nitrogen.

The cleavage products of albumen, S. G. HEDIN (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 191–196*).—The author describes a base isolated by him from casein, from albumen of white and yolk of egg, from blood serum, and from horn. The author thinks it is very likely that the chlorohydrate of the base is identical with that described by Siegfried.[1]

Researches on arabinose, BERTHELOT and G. ANDRÉ (*Compt. Rend., 123 (1896), No. 17, pp. 625–631*).—A study of the action of hydrochloric acid and phosphoric acid on arabinose under varying pressures.

Concerning luciferase or photogenetic zymase of animals and plants, R. DUBOIS (*Compt. Rend., 123 (1896), No. 17, pp. 653, 654*).

The accuracy of Winkler's method of determining oxygen in solution in drinking water, G. W. CHLOPIN (*Arch. Hyg., 27, No. 1, pp. 18–33*).

A new reagent for detecting and determining nitrites, M. C. SCHUYTEN (*Chem. Ztg., 20 (1896), No. 75, pp. 722, 723*).—When 5 cc. of a 1 per cent solution of antipyrin in acetic acid ($\frac{1}{10}$) is added to a solution containing nitrites, a green color quickly appears which is distinct for $\frac{1}{20000}$ of nitrite. Lime and alkalies, chlorids, bromids, iodids, sulphids (and H_2S), carbonates, phosphates, nitrates, borates, sulphates, the salts of potassium, sodium, ammonium, calcium, barium, magnesium, aluminum, zinc, iron (ferrous), lead, bismuth, cadmium, tin, as well as organic substances (sugar, alcohol, and phenol), if not in too concentrated solution, apparently do not affect the reaction.

On the determination of phosphoric acid in organic matter (*Ann. Agron., 22 (1896), No. 8, pp. 392, 393*).—The precautions to be observed to prevent fusion of the alkaline phosphates in incineration are discussed, and the methods of incineration in a current of carbonic acid proposed by Schlossing and with sulphuric acid are

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[1] Ber. deut. chem. Ges., 24 (1891), p. 428.

described. The method of digestion in sulphuric acid, as in the Kjeldahl method for nitrogen as employed by Garola, is favorably noted.

Determination of mustard oil in feeding stuffs, M. PASSON (*Ztschr. angew. Chem., 1896, No. 14, pp. 422, 423; abs. in Analyst, 21 (1896), Sept., p. 233*).

The detection of formol (formic aldehyde) in milk, G. DENIGÈS (*Jour. Pharm. et Chim., 1896, Sept.; abs. in Milch Ztg., 25 (1896), No. 2, p. 667*).

Method for detecting borax in butter, PLANCHON and VUAFLART (*Jour. Pharm. et Chim., 1896, ser. 4, p. 49; abs. in Milch Ztg., 24 (1896), No. 42, p. 668*).

Determination of the sugar and the molasses content of molasses feed, C. MÜLLER (*Landw. Vers. Stat., 47 (1896), No. 2-3, pp. 249-251*).

Application of the Röntgen rays in the analysis of vegetable substances, F. RANWEZ (*Assoc. Belge. Chim., 10 (1896), pp. 44-48; abs. in Analyst, 21 (1896), Sept., p. 233*).

A new shaking machine for laboratories, M. VON RECKLINGHAUSEN (*Ber. deut. chem. Ges., 29 (1896), No. 14, pp. 2372, 2373, fig. 1*).—Describes a machine of very simple construction suitable for shaking a number of small bottles or tubes at once.—A. M. PETER.

On a modification in the form of measuring flasks, H. BLITZ (*Ber. deut. chem. Ges., 29 (1896), No. 13, p. 2082, fig. 1*).—The modification consists in making the flasks with a bulb-like enlargement in the neck above the graduation mark to facilitate the mixing of the contents of the flask by shaking after making up to volume.—A. M. PETER.

On a convenient form of measuring flask, W. WISLICENUS (*Ber. deut. chem. Ges., 29 (1896), No. 15, pp. 2442, 2443, fig. 1*).—After referring to the measuring flask described by Blitz (see above), the author calls attention to the fact that similar flasks, but with double graduation, have been in use for some time. Such a flask, graduated to 1,000 and 1,100 cc. is figured and its use in making up normal solutions is described.—A. M. PETER.

Report of work at the State laboratory at Antwerp, Belgium, in 1895, D. CRISPO (*Rap. Trav. Lab. Etat, Anvers, 1895, pp. 16*).—Tabulated analyses of fertilizers, feeding stuffs, and foods; results of comparative tests of the citro-mechanical and molybdic methods for phosphoric acid; and comments on the fertilizer trade.

BOTANY.

Relation of the growth of foliage leaves and the chlorophyll function, D. T. MACDOUGAL (*Jour. Linn. Soc. Bot., 31 (1896), No. 218, pp. 526-546, pl. 1, fig. 1*).—A brief historical sketch is given of the investigations on the growth of leaves and their food-forming activity, and the results of some experiments by the author are stated. His experiments were conducted with *Arisæma triphyllum*, *Calla palustris*, *Hibiscus rosa-sinensis*, *Isopyrum biternatum*, *Justicia* sp., *Lilium tigrinum*, *Oxalis floribunda*, *O. vespertilionis*, *Phœnix dactylifera*, *Trillium erectum*, *T. erythrocarpum*, and *Zea mays*, and the effect of a lack of carbon dioxid, darkness, diffused light, and the removal of concurrent members is briefly stated.

According to the author, the following conclusions are sustained:

"(1) Material constructed in active chlorophyll areas and stored in special organs may be transported to inactive chlorophyll-bearing organs in some plants in light and in darkness, and be used in such manner as to allow of the perfect development of these organs.

"(2) The removal of concurrent members in darkness may have no effect, may cause

an exaggerated development of the petioles, or may result in the perfect development of the entire leaf. The nature of the regulatory mechanism in each instance must be entirely specific.

"(3) It is possible for some plants to form perfect leaves in darkness, some when a portion of the stem only is darkened, and others when the entire plant is etiolated. It is thus shown that no invariable connection exists between the phototonic condition and leaf development.

"(4) The conclusion of Jost, that pathological conditions ensue more quickly in inactive leaves in light than in darkness, is not capable of general application. The deterioration in certain plants appears as quickly in darkness as in others in light.

"(5) Placing a leaf under such conditions that it can not construct food material sets in motion the specific regulatory mechanism of the organism in such manner that the plastic material may be withdrawn and the organ cast off. An exaggerated development of the petioles may be induced in darkness by this mechanism.

"(6) Plants may not be entirely classified as to their reaction to an atmosphere devoid of carbon dioxid upon the basis of species, since a given plant may be capable of developing inactive leaves at one stage of its development and not at another. This is evident upon consideration of the fact that such capacity is entirely dependent upon the availability of the reserve food for this purpose."

A form of apparatus for growing plants in an atmosphere free from carbon dioxid is figured and briefly described.

Indian cultivated cottons, T. H. MIDDLETON (*Agl. Ledger, 1895, No. 8, Veg. Product series, No. 15, pp. VIII, 27, pls. 5*).—Botanical descriptions are given of about 40 Indian varieties of cotton, together with miscellaneous notes and descriptions of several others. The author distinguishes between *Gossypium herbaceum* and *G. hirsutum*. It is stated that the *G. herbaceum* of American authors is not that species as described by Linnæus. To this species the name *G. hirsutum* of Miller is given. Attention is directed to the almost hopeless confusion in the synonymy of the cultivated species of cotton.

Grasses of North America, II, W. J. BEAL (*New York: Henry Holt & Co., 1896, pp. VIII, 706, figs. 126*).—This is the concluding volume of the author's work on the "Grasses of North America," the first part of which appeared nearly 10 years ago. In the first volume the economic and related features were treated, the systematic arrangement and description of species being retained for this part. Students of agrostology will welcome the appearance of this valuable work, since for the first time there are brought together descriptions of all known species growing north of Mexico, as well as those collected in Mexico by C. G. Pringle and Edward Palmer. In handling such a mass of material while actively engaged with other duties, some errors have crept into the work, but these defects are not of sufficient number or importance to greatly affect the value of the entire work.

The author has followed the "Rochester code" in his system of nomenclature, and many new combinations are the result. Opinions will differ as to the proper generic name in several instances, it being a disputed question whether some of our American grasses may not have been wrongly referred.

Of the 912 species described in this work, many of them for the first time, 809 are native and 103 introduced grasses. In addition to describing all these species, the geographic distribution of the Gramineæ in North America is given, and interesting tables are constructed showing the proportional distribution of the species of many genera in the great divisions of the globe.

Analytical keys are given for most of the tribes and genera, but the absence of a general key to the family will be noticed. Its place is supplied by brief descriptions

of the two great divisions—Panicaceæ and Poaceæ. By many students this omission will be seriously felt, an acquaintance with the tribes or genera being almost essential to use of the descriptions.

The usefulness of the work for ready reference might have been improved had the generic names been given more prominence and repeated on each page, either with the specific name or as a side head at the top of the page, the generic name in several cases being 20 pages or more from the species described.

A bibliography of about 100 works relating to North American grasses and a very full index complete the work.

Phyllotaxy as a guide to plant analyses, A. L. BENEDICT (*Bul. Torrey Bot. Club, 23 (1896), No. 11, pp. 435–439*).

A systematic account of the Phalloideæ of the United States, E. A. BURT (*Bot. Gaz., 22 (1896), No. 5, pp. 379–391*).

A rearrangement of the North American Hyphomycetes, R. POUND and F. E CLEMENTS (*Minnesota Bot. Studies, Bul. 9, pt. 9, pp. 644–673*).

Concerning a new micromycete, F. TOGNINI (*Rend. R. Inst. Lomb. sci. e lett., ser. 2, 29 (1896); abs. in Hedwigia, 35 (1896), No. 5, p. 119*).—Notes are given of *Acremoniella verrucosa*, which is probably the cause of a new grain disease.

New species of micromycetes, F. TASSI (*Atti. della R. Acad. Fisiocritici, ser. 4, 8 (1896), p. 10; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 19, pp. 616–618*).

Remarks on the inflorescence of Rosa, F. CRÉPIN (*Bul. Soc. Roy. Bot. Belgique, 34 (1895), II, pp. 32–53*).

Investigations on the anatomy of the Betulaceæ and Corylaceæ, A. M. BOUBIER (*Contr. Bot. Lab. Univ. Geneve, ser. 3, 6 (1896), pp. 91, figs. 24*).—Anatomical studies were made of Betula, Alnus, Corylus, and Carpinus.

Investigations on the growth and anatomical structure of the ash (Fraxinus excelsior), F. SCHNEIDER (*Forstl. naturw. Ztschr., 5 (1896), No. 11, pp. 421–438*).

A study of some anatomical characters of North American Gramineæ, VII, T. HOLM (*Bot. Gaz., 22 (1896), No. 5, pp. 403–406, pl. 1*).—Notes are given on *Amphicarpum floridanum* and *A. purshii.*

A contribution to the biology of Myxomycetes, C. LIPPERT (*Verhandl. zool. bot. Ges. Wein, 1896, p. 235; abs. in Hedwigia, 35 (1896), No. 5, p. 100*).—An account is given of the sporangia of *Physarum cinereum ovoideum, Didymium microcarpum, Chondrioderma difforme,* and *Cribraria* sp.

On the stem anatomy of certain Onagraceæ, F. RAMALEY (*Minnesota Bot. Studies, Bul. 9, pt. 9, pp. 674–690, pls. 3*).—The author was unable to find any characters of sufficient constancy to use in systematic determination.

Concerning the relation of the form of the leaves of Campanula rotundifolia to light intensity, K. GOEBEL (*Sitzungsber. math. physikal. Akad. Wissensch. München, 1895, No. 3, pp. 331–335*).

On the correlation of heliotropism and geotropism, F. CZAPEK (*Sitzungsber. kgl. Akad. Wissensch. Wien, vol. 104; abs. in Bot. Centbl., 68 (1896), No. 4, pp. 117–119*).

Ascent of water in trees, F. DARWIN (*Gard. Chron., ser. 3, 20 (1896), No. 509, pp. 374, 375*).—A brief abstract is given of a paper read by the author before Section K of the British Association at its meeting September 18, 1896.

Influence of continued electric currents on the decomposition of carbonic acid in aquatic plants, M. THOUVENIN (*Rev. gén. Bot., 8 (1896), No. 95, pp. 433–450*).

Abnormal formation of resin ducts and other anatomical changes in the wood of diseased conifers, A. P. ANDERSON (*Forstl. naturw. Ztschr., 5 (1896), No. 11, pp. 439–454*).

Unnatural colors in foliage (*Garden and Forest, 9 (1896), No. 457, pp. 471, 472*).

Green and blue colors in leaves and flowers, H. MOLISCH (*Wiener Illus. Gart. Ztg., 20 (1896), No. 8–9, pp. 287–301*).—The author gives a résumé of information relative to chlorophyll and anthocyan.

External characteristics of root tubercles of Leguminosæ, D. CLOS (*Compt. Rend., 123 (1896), No. 9, pp. 407–410*).

Recent investigations on the bacteria of the tubercles of legumes and the fixation of nitrogen through their agency, STUTZER (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 20, pp. 650–653*).—A résumé is given of a few works which appeared during the past year or two.

Present position of morphological botany, D. H. SCOTT (*Nature, 54 (1896), No. 1405, pp. 535–543*).—Presidential address before Section K of the meeting of the British Association September 17, 1896.

On the use of gelatin in preparing large material for demonstration, J. WORTMANN (*Bot. Ztg., 54 (1896), II, No. 22, pp. 337–340*).—A method is given for the use of gelatin in preparing large specimens for microscopical examination.

Some aqueous media for preserving algæ for class material, W. A. SETCHELL and J. V. OSTERHOUT (*Amer. Micros. Jour., 17 (1896), No. 11, pp. 378–384*).—Directions are given for the preparation and use of solutions of chrome alum, formalin, and camphor water for different groups of algæ.

Report of the botanist, G. E. STONE (*Massachusetts Hatch. Sta. Rpt. 1895, pp. 173–176*).—The author mentions the reëstablishment of the botanical department of the station and briefly outlines the work begun or to be investigated.

METEOROLOGY.

Meteorological observations, 1895, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1895, pp. 111–113*).—This includes comments on the weather during the season; monthly summaries of observations at Storrs on atmospheric pressure, temperature, rainfall, relative humidity, precipitation, and cloudiness; and a record of rainfall at 21 localities in the State during the 6 months ending October 31.

"The total precipitation for the year (45.7 in.), as measured at Storrs, was nearly up to the average for the State. The average for this State from observers having observations covering 10 years or more prior to 1890, is 49.1 in., and the average at Storrs for the past 7 years is 44.7 in. The precipitation was least during the months of February, May, and June. The early part of the growing season was exceptionally dry, and the hay and strawberry crops were considerably reduced in yields below an average crop. During the remainder of the growing season, light rainfalls were frequent and most crops were fairly well supplied with moisture. . . .

"The temperature for January was about the average, while February was exceptionally cold. March gave a low average temperature, but April was mild and favorable for farm work. Severe frosts occurred as late as May 14 and 17, doing some damage to early vegetables. The temperature for the summer months was not high. The highest temperature occurred early in June and the third week in September. Light frost occurred on September 15, but the first killing frost came October 15, thus giving a growing period of 150 days since the last severe frost in the spring. The average growing season at this station for the past 7 years has been 144 days. The last 3 months of the year were comparatively mild, but gave an unusually large amount of rainfall."

Meteorological summary for 1895, V. E. MUNCY (*Kentucky Sta. Rpt. 1895, pp. LX–LXVI*).—Meteorological summaries are given of observations on temperature, pressure, precipitation, cloudiness, wind movement, and other phenomena. The annual summary is as follows: *Temperature* (degrees F.).—Maximum, 95, September 20; minimum, −13, February 8; mean monthly, 54.1; mean daily range, 18.1. *Pressure* (inches).—Highest, 29.42, November 27; lowest, 28.24, January 25;

mean, 29.01. *Precipitation* (inches).—Total, 35.32; number of clear days, 95; partly cloudy, 108; cloudy, 162. *Wind* (prevailing direction).—SW. Number of days on which thunderstorms occurred, 19; snow, 24; hail, 2; fog, 2.

A résumé of solar observations made at the royal observatory of the Roman College during the first half of 1896, P. TACCHINI (*Compt. Rend., 123 (1896), No. 7, pp. 375–377*).

Weather record at Newport (Arkansas) Substation for the season 1894, G. B. IRBY (*Arkansas Sta. Rpt. 1895, p. 32*).—Reprinted from Bulletin 31 of the station (E. S. R., 6, p. 878).

Meteorological observations at Camden, Arkansas, 1894, C. L. NEWMAN (*Arkansas Sta. Rpt. 1895, p. 128*).—Reprinted from Bulletin 34 of the station (E. S. R., 7, p. 97).

Meteorological summary for 1895 (*Maryland Sta. Rpt. 1895, pp. 220, 229*).—General notes on the weather conditions of the year and a summary of observations on temperature and precipitation. The precipitation for the year was 35.54 in., the mean temperature 53.1° F., the maximum 101° (Sept. 23), minimum 7° (Feb. 3), and daily range 22.5°.

WATER—SOILS.

The Florida parishes of east Louisiana, W. W. CLENDENIN (*Louisiana Stas. Special Rpt. pt. 3, pp. 163–256*).—This is a continuation of the work of O. Lerch on the geology of north Louisiana (E. S. R., 5, p. 282), and deals with the greater part of the State of Louisiana south of the thirty-first degree, including the Florida parishes of east Louisiana and the bluff hill and prairie sections of southwest Louisiana.

"The section lies between the Mississippi River on the west and the Pearl River on the east, and is bounded on the south by Lake Ponchartrain, Lake Maurepas, and Bayou Manchac. It includes 8 parishes . . . and comprises an area of about 4,500 square miles. . . .

"The purely alluvial parishes are not here considered, inasmuch as they, being (up to the present) the chief agricultural lands, it was thought best to make a separate report upon them. Only those alluvial soils that lie in proximity to the older soils, in parishes that contain both, are here treated. . . .

"The object being to make an agricultural rather than a purely geological report, particular attention was given to the origin, nature, and depth of soil; to water supply and questions of drainage, and especially to the character of the natural or virgin growth upon the lands, where obtainable, as being one of the truest indices of their nature and possibilities."

Different chapters of the bulletin are devoted to description of area, including geography and history, topography and drainage, the mounds, natural ponds, geological history, brief history of the Lafayette formation, brief history of the Columbia formation, soils, economic products, including mineral and vegetable products, climate, the 5 islands, and some geological sections (pine hills, pine flats, prairies, and bluff), with an appendix by W. R. Dodson on the principal plants of economic value in this region.

A peculiar topographical feature of this region is the mounds, which "attain their greatest development in the prairies around and near the sulphur mine in Calcasieu Parish."

The formation of these mounds is ascribed not to the activity of ants, but to the escape of gas through fractures produced by earthquake shocks in the strata, the gases, in their passage through the water, carrying up from below the sand which is the peculiar constituent of these mounds.

As regards the geological history of the region, it is stated that—

"The Florida parishes are a part of the coastal plain that borders the Atlantic Ocean and Gulf of Mexico from New England to and beyond the Rio Grande. The coastal lowland, averaging about 150 miles in width, may everywhere be divided into 2 and often 3 distinct types of topography.

"The 'low grounds' of the Carolinas and the 'pine meadows' and 'pine flats' of Alabama, Mississippi, and Louisiana, constituting the seaward division of the coastal plain, are, as has been described, topographically young. Their illy drained areas extend up all the transecting primary streams and many of the secondary.

"The landward division of the coastal plain is topographically mature. Its perfectly drained surface is made up of a succession of hills and ridges whose even crests show them to be the tattered remnants of a former peneplain.

"The third type of topography is found as bordering zones along the great streams whose tributary sources were in the regions of the northern continental ice sheet. While the sediments constituting the strata of this type were deposited quite as late as those of the pine flats, yet the attitude of the land is such that topographic forms have been of rapid development, and the topography of these areas is not inaptly styled adolescent.

"This coastal lowland, constituting the most recent important addition to our continent, belongs to the Lafayette and Columbia formations. These formations, recent subdivisions of the Orange Sand of Hilgard and other geologists who studied this region, while not fully determined as to exact geological position, are probably late Tertiary and Quaternary. Being almost destitute of fossils, biologic criteria can not be used in fixing them in the geologic section, and resort must be had to the principle that 'geologic history may be read from the configuration of the land as readily as from the contemporaneous rocks and fossils.' This being the case, a geologic province should include alike the areas of degradation and concurrent deposition."

Applying this method, a brief history of the Lafayette and Columbia formations is worked out.

In the Florida parishes sandy, clay, and humus soils are distributed over large areas.

"From the nature of the deposit the greatest amount of humus is found in the soils of the river bottoms, especially the first bottoms, that are subject to overflow.

"The 'second bottoms' and 'pine flats' while containing considerable amounts of humus are more especially characterized by the development of that distinctly clayey group of strata, the Port Hudson, which produces a heavy soil.

"Moreover, much of the soluble plant food from the hill soils has been deposited there.

"These all combine to make these soils inherently fertile or strong. This has long been recognized in the modern alluvial deposits over the flood plains of streams, but as yet unappreciated in the 'flats' and 'second bottoms' that constitute nearly one-half of those parishes east of the Amite.

"In their present undrained condition these soils are sour and unproductive. This can be completely corrected by thorough drainage and some addition of lime to assist in changing the brown, soluble humus into the true black humus desired.

"When this is done these lands will become among the most valuable in the State.

"Over the hills of these parishes, east of the zone of 'bluff' bordering the

Mississippi River, is spread a thin coating of brownish-yellow, clayey loam that is highly productive. Immediately underlying it at a depth varying from a few inches to a few feet is the much more sandy Lafayette, which, when it becomes the upper soil from removal of the yellow loam by erosion, loses its soluble plant food rapidly by leaching. Great care should therefore be exercised to preserve this protective coating from being removed by washing. This can be done by proper cultivation, and by resorting as much as possible to those crops that require the least stirring of the soil. . . . Throughout these parishes are found 'old fields' aggregating thousands of acres that were once productive, but lost their productiveness by inattention to this matter of preservation of the fertile but easily removable coating of loam.

"Along the banks overlooking the ancient Mississippi is found a soil, the loess or 'bluff' of which combines perhaps more of the elements of productiveness than any other soil in the State.

"Being well above the flood plains of the streams it is easily drained; and containing much more of clay than sand, it does not leach rapidly.

"Rich in lime, humification, even in poorly drained areas, is rapid and of the desirable kind.

"Yet, being so fine grained and incoherent, this deposit erodes rapidly, and the greatest care should be exercised to prevent this wastage by erosion.

"Four classes of soils are then found in the Florida parishes, corresponding to the three upper members of the Columbia formation, and the modern alluvial deposits in our river bottoms. Each has its characteristic vegetation."

The region is not generally rich in mineral products, but contains the Petite Anse deposit of rock salt. It furnishes large quantities of pine and some hard-wood lumber. Resin and turpentine are gathered to some extent, and native fruits and flowers are abundant. Cultivated crops are principally cotton on the uplands and hills and rice and cane in the alluvial lands.

"Throughout south Louisiana maximum temperatures of 100° F. are extremely uncommon, and minimum temperatures below 20° F. are even more rare. Upon the coast freezing temperatures are infrequent.

"The range of temperature is about 70° F. in the northern portion of the section and decreases as we approach the coast.

"The annual precipitation varies from 50 to 70 in., being in the northern part usually between 60 and 65 in., and decreasing toward the coast, where it is commonly under 50 in. This is well distributed throughout the year. Though there is a minimum of rainfall in midsummer, no season can be considered as distinctively dry.

"The winds are variable, though prevailingly southern. Thunderstorms are common, and are usually accompanied by strong winds.

"Though south of the most frequented tracks of tornadoes, many destructive storms pass through the section, following, as elsewhere in the Mississippi Valley, a course from southwest to northeast. . . .

"Summing up, we may say: The section is one of moderate range of temperature, being less as we approach the coast; of sufficient though not excessive rainfall, likewise diminishing toward the coast, and being well distributed through the year; of variable though prevailingly southern winds; and occasional destructive storms.

"Taken as a whole, the climate may be properly called temperate."

A brief description is given of the detached and limited areas known as the "islands" of Orange, Petite Anse, Grand Cote, Cote Blanche, and Belle Isle, which rise so conspicuously above the surrounding prairie and marsh and which constitute a topographic feature of the coastal plain that has no other American homologue.

The effect of acidity on the development of nitrifying organisms, E. E. EWELL and H. W. WILEY (*Jour. Amer. Chem. Soc., 18 (1896), No. 6, pp. 475–484*).—A brief history of investigation on the transformation of nitrogen in the soil and on the influence of the reaction of media on the growth of organisms is given. One hundred cubic centimeter portions of a solution, composed of ammonium sulphate 0.943 gm., di-potassium hydrogen phosphate 1 gm., magnesium sulphate 0.5 gm., calcium chlorid trace, and water 1,000 cc., were inoculated with portions of 40 samples of soils from different parts of the United States, and the amount of nitrogen nitrified during 2 months determined. Before the addition of the ammonium salt the acidity of the culture medium was such that 1 liter of it required 2.6 cc. of normal sodium hydroxid solution to make it neutral to phenolphthalein. On an average 28 parts per million of nitrogen were nitrified during the 2 months, but nitrification stopped "after the formation of an acidity equal to 3 to 4 cc. normal alkali. . . . The organisms coming from various parts of the country seem to be very uniform in regard to their ability to endure acidity."

Similar results were obtained when the tests were repeated with pure cultures of organisms isolated from the different soils. It was shown that the nitric ferment was able to endure at least as much acidity as the nitrous ferment.

The presence of nitrites in the air, G. DEFREN (*Tech. Quart., 9 (1896), No. 2 and 3, pp. 238–245*).—It was found that water exposed to the air of well-ventilated rooms absorbed small quantities of nitrites, the amount increasing with time of exposure, and depending upon the character of the work going on in the room. The burning of illuminating gas results in the formation of some nitrites. The lowest amount observed was 0.014 part per 10,000 of water, the highest 0.0707 part. If the air was drawn through the water no reaction for nitrites was obtained, the same being true when the breath was blown through distilled water. It is suggested that the deleterious effect of air of overcrowded rooms may in part at least be accounted for by the presence of nitrites which possess poisonous properties.

Artesian wells as a means of water supply, W. G. COX (*Brisbane: Capsford & Co.; New York: Van Nostrand Co.*).

Typhoid fever in Indiana and its possible connection with water supplies, S. BURRAGE (*Purdue University Monographs, Public Health Series, No. 3 and 4, pp. 21–29*).—The nature and dissemination of typhoid fever is discussed and precautions to be observed to prevent contamination of water supply are explained.

On the purification of water supplies of cities and towns, S. BURRAGE (*Purdue University Monographs, Public Health Series, No. 3 and 4, pp. 1–20, figs. 4, pl. 1*).—This is a popular discussion of the impurities commonly found in drinking waters, and some of the latest methods for purification of water.

A study of the water of different springs in the park in Grignon, J. CROCHETELLE (*Ann. Agron., 22 (1896), No. 10, pp. 469–484, figs. 2*).—The amount of nitric nitrogen carried off in the natural drainage is estimated.

A study of the waters along the railway from Sfax to Loued Seldja, E. BERTAINCHAUD (*Bul. Agr. et Commerce, 1 (1896), No. 1, pp. 36–41*).

Water analysis, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 223–225*).—The method followed in water analysis is described, and instructions for sending samples are given. Analyses have been made of 124 samples. Sample analyses of different waters are given.

The absorptive power of humus soil, M. LACHAUD (*Bul. Soc. Chim. Paris, ser. 3,*

15-16 (1896), No. 18-19, pp. 1108-1110).—Tests of the absorptive power of sterile and humus soil for dextrin and gelatin are reported, showing that the presence of humus greatly increases this property in soils.

The conservation of moisture in the soil (*Garden and Forest, 9 (1896), No. 450, pp. 401, 402*).

The influence of growing plants upon soil moisture, E. D. SANDERSON (*Southern Ruralist; Florida Farmer and Fruit Grower, 8 (1896), No. 41, pp. 645, 646*).—A popular article based upon experiments made in Germany and by the stations in the United States.

FERTILIZERS.

The assimilability of nitric and ammoniacal nitrogen by plants, PAGNOUL (*Ann. Agron., 22 (1896), No. 10, pp. 485-490*).—These two forms of nitrogen were compared with each other on beets, cameline (*Camelina sativa*), clover, and oats grown in pots of about 25 liters capacity filled with sterile sand. Three pots were devoted to each test, the first receiving no fertilizer, the second phosphate of soda and nitrate of potash, and the third phosphate of soda, muriate of potash, and sulphate of ammonia.

The sulphate of ammonia proved decidedly superior to the nitrate, giving yields nearly double the yield of beets, clover, and oats, and over three times the yield of cameline produced by the nitrate.

The unfertilized plants contained a small amount of nitrogen, but the proportion was largely increased when fertilizers were applied. No trace of nitric nitrogen was found in the unfertilized plants. It was abundant, however, in plants which had received nitrates and in much less but still appreciable quantities in those which had received sulphate of ammonia.

The indications are that the ammonia salt was directly assimilated and was more rapidly taken up than the nitrate. Examinations of the crops on June 6 and 22 showed that during that period the nitric nitrogen had greatly decreased in the cases where nitrates were used, and it is inferred that this nitrogen was used to build tissue. Ammoniacal nitrogen was also determined. Very small amounts were found, on the average a little more in the plants to which nitrates were applied than in those receiving the ammonia salt.

The water content of the plants receiving sulphate of ammonia was smaller than that of those fertilized with nitrates.

The method used in determining nitric nitrogen in these investigations was as follows: Dry the material at 105° C. and grind fine while still warm. Place 2 gm. of the powder in a porcelain dish with a little water and heat to boiling for a few minutes. Cool and add 6 to 10 drops of subacetate of lead, mix, and then add 1 gm. of animal black which has been washed with acid. Let stand for 1 hour, shaking from time to time, filter into a 50 cc. flask, and make up to mark. Evaporate 5 cc. of this solution to dryness, add a dozen drops of phenol-sulphuric acid (10 gm. phenol in 70 of acid), mix thoroughly, add a little water, and then ammonia. A yellow coloration due to picrate of ammonia appears if nitric nitrogen was present in the original material. The amount of

nitric nitrogen originally present is determined by comparing the tint obtained with that of a type solution of picrate of ammonia (1 mg. per liter).

For the determination of ammoniacal nitrogen grind 10 gm. of the fresh plant in a mortar and place it in a flask with 50 cc. of water, 0.5 gm. of magnesia, a few pieces of pumice stone, and a small quantity of paraffin. Connect the flask with a condenser and distill off about three-fourths of its contents into a flask containing a few drops of very dilute sulphuric acid. Make up the distillate to 50 cc. and test with Nessler solution.

Vegetation experiments on the availability of nitrogen in certain nitrogenous materials, S. W. JOHNSON, W. E. BRITTON, and E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 99–116*).—Work of previous years in this line (E. S. R., 7, p. 191) was continued during 1895. To the soils (in pots) used the previous year additional fertilizing materials were added and a crop of oats was grown, followed by a crop of corn. The nitrogenous fertilizers tested and the method pursued were practically the same as in 1894.

The oat plants receiving organic nitrogen were sickly in appearance and some of those receiving the heavier applications died. The corn crop was also very irregular.

"Our own experiments illustrate what has been abundantly demonstrated by others, that the weight of dry matter harvested (water-free crop) is no certain measure of the nitrogen assimilated by the crop; . . . but the determination of the nitrogen actually taken up by the crops from the fertilizer makes the results intelligible."

Consequently this basis is adopted for the calculation of the availability of the different forms of nitrogen. The details are tabulated and discussed in full.

Summarizing this data, the relative efficiency of the various fertilizers as sources of nitrogen to the corn and oat crops in 1894 and 1895 may be stated (in round numbers) as follows:

Relative efficiency of different forms of nitrogen on corn and oats, 1894, 1895.

	Available nitrogen reckoned on total nitrogen.	Available nitrogen reckoned on the available nitrogen of nitrate of soda.
	Per cent.	*Per cent.*
Nitrate of soda	68.0	100
Castor pomace A	53.0	77
Castor pomace B	48.0	70
Average of castor pomace A and B	50.5	74
Cotton-seed meal	49.5	72
Linseed meal	47.0	69
Dried blood	46.5	68
Dry fish	45.0	66
Dissolved leather	44.5	64
Horn and hoof	42.5	62
Tankage	40.5	59
Steamed leather	6.5	9
Roasted leather	6.5	9
Raw leather	1.5	2

"The experiments of 1895 just described do not by any means conclude the subject, but are rather a report of progress, and have been purposely described so as to present fully their defects. The investigation will be continued during the coming season.

"The indications of the present year's tests agree with those of 1894 in these respects, that the nitrogen of castor pomace A has shown the highest availabilty of any form of organic nitrogen; that fish, horn and hoof, and tankage have manifested the lowest availability, leather excepted; while cotton-seed meal, castor pomace B, linseed meal, and dried blood stand intermediate, with no very striking difference between the four."

In determining the amount of nitrogen in the oat crops it was found that many of them contained nitrates. Direct determinations in 9 samples gave from 0.05 to 1 per cent of nitric nitrogen.

Loss of fertilizer nitrogen, E. H. JENKINS and W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 95–98*).

"Fifty grams of surface soil from the station garden (which is annually dressed liberally with mixed cow and horse manure and with fertilizer chemicals), 50 gm. of fresh cow dung and 50 gm. of fresh horse dung were stirred up with water, each in a separate vessel, and the muddy liquids were strained through tufts of glass wool. This was repeated till the volume of the filtered liquid amounted in each case to 750 cc. To each was then added 5 gm. of sodium nitrate and water to make 1,000 cc.

"Nitrogen as nitrates was immediately determined in each solution. The flasks were tightly stoppered and kept in a closet nearly dark. From time to time nitrogen was again determined. . . .

"It appears that in the extract of garden soil, very little nitrogen was lost through reduction of nitrates during 10 months.

"The extracts of fresh horse dung and fresh cow dung caused considerable loss of nitrogen from the nitrates by reduction. The reduction by the extract of cow dung was in this experiment somewhat slower and less in amount than that of the horse dung.

"While the gains and losses of nitrate nitrogen in several cases are within the limits of analytical error, it is probable that in the extract of horse dung after May 24 nitrates began to increase by nitrification of the organic nitrogen.

"In a further experiment 2 extracts were prepared in precisely the way above described, the one from 50 gm. of fresh horse dung, the other from 50 gm. of a potting soil prepared for use in the forcing house. This was made of pasture sod and the soil just beneath, composted with about one-third their bulk of mixed horse and cow manure. The mixture made in the summer of 1894 had stood in a conical compact pile exposed till the fall of 1895. The soil for this experiment was taken from the interior of this pile at a depth of 2 to 3 ft.

"To each of the extracts prepared as above and measuring 1,000 cc., 5 gm. of nitrate of soda was added."

The recorded determinations of the amount of nitric nitrogen at different dates show that "while the surface soil of the garden, although heavily dressed each year with stable manure, had little or no effect in destroying nitrates, the potting earth (made by composting contiguous pasture sod and a few inches of underlying soil with stable manure), reduced nitrates to about half the extent caused by fresh horse dung."

The cultural value of different phosphates, P. DE VUYST and P. NYSSENS (*Deuxième Rapport, Brussels, 1896, pp. 27*).—This is an account

of experiments in continuation of those carried out in 1894 (E. S. R., 7, p. 24) for the purpose of determining the relative agricultural value of superphosphate, Ciply and Liège phosphates, and Thomas slag. Data are tabulated in detail for experiments in 1895 on oats following beets, peas following maize, clover following oats, wheat following clover, and on dry and wet meadows.

Summarizing the results for the 2 years, it appears that as regards yield the superphosphate gave the best results on oats following clover, on clover following wheat, and on dry meadows; and the slag gave best results in the oats-beet, and peas-corn rotation, and on wet meadows. With respect to profit secured, the slag gave the best results in every case except on the dry meadows, on which the superphosphate gave the most profitable return. The latter also gave a profit in all other cases except on the wet meadows. As regards the amount of phosphoric acid which the plants utilized of the different applications, the slag appears in most cases to stand ahead of the other phosphates. In general it is recommended that for soils of the character used in these experiments the superphosphate or slag should be used, since they give an increase of yield and a profit double that of the mineral phosphates.

Fertilizers (*Connecticut State Sta. Rpt. 1895, pp. 1–74*).—A statement of the amount of fertilizers used in Connecticut; an abstract of the State fertilizer law; a list of manufacturers complying with the law; notes on the sampling and collection of fertilizers; explanations concerning the analysis and valuation of fertilizers; methods and results of home-mixing of fertilizers; a review of the fertilizer market for the year ending November 1, 1895; and tabulated analyses and valuations of 194 samples of fertilizing materials, including nitrate of soda, dried blood, leather, cotton-seed meal, castor pomace, dry ground fish, beef scrap, tankage, bone, mineral phosphates, dissolved boneblack, dissolved rock phosphates, sulphate of potash, sulphate of potash and magnesia, muriate of potash, cotton-hull ashes, wood ashes, anthracite coal ashes, saltpeter waste, swamp muck, marine mud, and factory-mixed and home-mixed fertilizers.

The principal results of the inspection may be summarized as follows:

"Of the 76 analyses of nitrogenous superphosphates [examined] 21 are below the maker's minimum guaranty in respect of 1 ingredient, 5 in respect of 2, and 1 in respect of all 3 ingredients. Thus more than one-third of the whole number do not fulfill in all respects the maker's claim for them. . . .

"The average cost of the superphosphates is $32.32. The average valuation is $23.37, and the percentage difference 38.2. . . .

"Of the 78 brands of special manures 19 are below the manufacturers' guaranty in respect of 1 ingredient and 10 in respect of 2 ingredients, so that in all, considerably more than one-third of the whole number do not in all respects fulfill the manufacturers' claims. Rejecting from calculation 3 analyses, the average cost of 75 special manures was $37.33 per ton. The average valuation was $27.94. The difference, $9.39, is equivalent to a 'percentage difference' of 33.6. Last year the

corresponding figures were, average cost $38.13, average valuation $28.62, percentage difference 33.2. . . .

"The average cost per ton of the 24 brands of bone manures analyzed has been $32.09, and the average valuation $31.03 per ton. . . .

"Cotton-seed meal has been by far the cheapest source of available nitrogen, during the past season. Experiments indicate that it is as rapidly and fully available as the best forms of animal matter. It has been extensively used this year in home-mixed fertilizers and has given perfect satisfaction. . . .

"Castor pomace is an expensive form of organic nitrogen at present prices, and is used chiefly by certain tobacco growers who still prefer it to cotton-seed meal. The Poquonock experiments indicate that cotton-seed meal in equivalent quantity yields tobacco of the same quality in all respects as castor pomace, and at a much lower cost for fertilizers. . . .

"In acid rock phosphate available phosphoric acid has cost on the average very considerably less than in dissolved boneblack. Those who have tried the acid phosphate in home-mixed fertilizers report very favorably, finding little or no trouble from caking or 'setting' after mixing. There is no reason in the claim that the 'available' phosphoric acid of the dissolved rock phosphates is any less valuable agriculturally than that of dissolved boneblack. . . .

"Potash in the sulphates, both high and low grade, has cost about 1 ct. more per pound than in the muriates. . . .

"Allowing 6, 5½, and 2 cts. per pound respectively for soluble, reverted, and insoluble phosphoric acid, the price of actual potash in 20 samples of cotton-hull ashes has ranged from 4.3 cts. to 13 cts. per pound, the average being 6.1 cts. . . .

"The fact that cotton-seed meal and dissolved phosphate rock sold at very low prices during the last winter and spring induced many farmers to mix their own fertilizers who had not previously done it.

"Fifteen samples of these home mixtures have been analyzed at this station. . . .

"These fertilizers as a rule have a higher percentage of nitrogen and of potash than the average of factory-mixed goods and considerably less phosphoric acid. . . .

"The mechanical condition of these home mixtures has been uniformly good, and not noticeably different from that of factory-mixed goods."

The experience of the farmers was favorable to the home mixtures as regards both effectiveness and economy.

Commercial fertilizers, E. B. VOORHEES (*U. S. Dept. Agr., Farmers' Bul. 44, pp. 24*).—A popular bulletin on the composition and use of commercial fertilizers, in which the following topics are discussed: The need of commercial fertilizers; fertilizer requirements of different soils and crops; forms, sources, and composition of fertilizing materials—nitrogen, phosphoric acid, and potash; agricultural *vs.* commercial value of fertilizers; variations in the composition of manufactured fertilizers; the purchase of fertilizers; conditions under which fertilizers may be profitably used; the kind of fertilizer to use; and the systematic application of fertilizers. The principal features of this bulletin are brought out in the following summary:

"(1) Commercial fertilizers are mainly valuable because they furnish the elements—nitrogen, phosphoric acid, and potash—which serve as food, not as stimulants.

"(2) The kind of farming in the past and the demands for special products in the present make their use necessary in profitable farming.

"(3) In order to use them profitably the farmer should know—

"(*a*) That nitrogen, phosphoric acid, and potash are the essential manurial constituents;

"(*b*) That the agricultural value of these constituents depends largely upon their chemical form;

"(*c*) That these forms are contained in specific products of a well-defined character and composition, and may be purchased as such from dealers and manufacturers and may be mixed successfully on the farm.

"(4) The agricultural value of a fertilizer bears no strict relation to the commercial value; the one is determined by soil, crop, and climatic conditions, the other by market conditions.

"(5) The variations in the composition and value of manufactured fertilizers which contain the three essential constituents are due to variations in the character and in the proportion of the materials used.

"(6) The ton basis alone is not a safe guide in the purchase of these commercial fertilizers. Low ton prices mean either low content of good forms of plant food or the use of poorer forms. Fertilizers, high grade both in quality and quantity of plant food, can not be purchased at a low price per ton.

"(7) The best fertilizers can not exert their full effect on soils that are too dry or too wet, too compact or too porous. They can furnish but one of the conditions of fertility.

"(8) The kind and amount to use should be determined by the value of the crop grown and its power of acquiring food.

"(9) A definite system or plan should be adopted in their use; 'hit or miss' methods are seldom satisfactory, and frequently very expensive."

The best economy of concentrated fertilizers, S. W. JOHNSON (*Connecticut State Sta. Rpt. 1895, pp. 162–165*).—A general discussion of this subject intended simply "to illustrate the fact that the interests of those who buy as well as of those who sell commercial fertilizers can be best promoted by a knowledge, well applied, of all the factors of crop production."

Observations on the injurious effect of nitrate of soda, A. STUTZER (*Deut. landw. Presse, 23 (1896), No. 66, p. 592*).—Numerous instances are reported in which cereals (rye and occasionally wheat) were unhealthy on fields to which nitrate of soda had been applied. It is suggested that there was a deficiency of water as the season advanced and the soil solution of nitrate became too concentrated.

On the microbiology of nitrification processes, S. WINOGRADSKY (*Centbl. Bakt. und Par. Allg., 2 (1896), Nos. 13, pp. 415–428; 14, pp. 449–458*).

Concerning nitrate destroying bacteria, A. STUTZER and R. MAUL (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 15, pp. 473, 474*).

The proper management of stable manure in the stable, in the manure heap, and in the field (*Deut. landw. Presse, 23 (1896), No. 89, p. 791*).

The preservation of stable manure, P. WAGNER (*Landbote, 17 (1896), No. 27, p. 244*).

Sewage disposal in cities and towns, S. BURRAGE (*Purdue University Monographs, Public Health Series, No. 5, pp. 16*).—This is a popular discussion of the nature and composition of sewage; of old methods of sewage disposal; and of modern methods of sewage purification, including broad irrigation, intermittent filtration, sedimentation, subsurface disposal, mechanical filtration, and chemical precipitation.

Sewage disposal on the farm, T. SMITH (*U. S. Dept. Agr., Farmers' Bul. 43, pp. 20, figs. 8*).—A popular treatise including the following topics: Disposal of night soil, liquid sewage, kitchen and chamber slops, and waste and garbage; and protection of drinking water, including ways of contamination and construction of wells. Without attempting to make any definite suggestions applicable to all conditions it is urged that "the principles to be kept in the foreground are the disposal of sewage in the superficial layers of the soil in not too great quantity, the disinfection of the stools of the sick with lime before such disposition is made, the digging of wells in places kept permanently in grass and at some distance from barnyards, and, above all, their thorough protection from contamination from the surface and from the soil immediately below the surface."

Analyses of commercial fertilizers, M. A. SCOVELL, A. M. PETER, and H. E. CURTIS (*Kentucky Sta. Rpt. 1895, pp. 59–72; 133–142*).—Reprints of Bulletins 56 and 60 of the station (E. S. R., 7, p. 491; 8, p. 40).

Composition of commercial fertilizers, H. B. MCDONNELL ET AL. (*Maryland Sta. Bul. 40, pp. 69–121*).—This bulletin includes a schedule of trade values of fertilizing

ingredients; a list of fertilizers licensed for sale in Maryland for the year ending January 31, 1897; and tabulated analyses and valuations of 390 samples of fertilizers examined during the period from March to July, 1896.

Official inspection of commercial fertilizers and general chemical work in 1895, C. A. GOESSMANN (*Massachusetts Hatch Sta. Rpt. 1895, pp. 313–328*).—A brief account is given of the work of fertilizer inspection and of the general work in the laboratory of the chemical division of the station, accompanied by a list of the fertilizer manufacturers complying with inspection laws in the State, and tabulated analyses of 14 samples of ashes from a crematory furnace at Lowell, Massachusetts.

Compilation of analyses of fertilizing materials, H. D. HASKINS (*Massachusetts Hatch Sta. Rpt. 1895, pp. 328–345*).—Tables show the composition (maximum, minimum, and average for the 3 essential ingredients) of fertilizing materials analyzed at Amherst, Massachusetts, since 1868 in percentages and in pounds per ton.

Analyses of fertilizers, C. A. GOESSMANN (*Massachusetts Hatch Sta. Bul. 40, pp. 20*).—A schedule of trade values is given, together with tabulated analyses of 189 samples of fertilizing materials, including sulphate of potash, muriate of potash, ashes, tankage, bone, natural phosphates, cotton-seed meal, and mixed fertilizers.

The royal Saxon agricultural experiment station at Möckern. Report of the work of the fertilizer control in 1895, O. BÖTTCHER (*Sächs. landw. Ztschr., 44 (1896), Nos. 34, pp. 415–418; 35, pp. 429–432*).

FIELD CROPS.

Observations on the growth of maize continuously on the same land for 8 years, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 216–225*).—This is a continuation of work published in the Annual Report of the station for 1894 (E. S. R., 7, p. 198).

Beginning with 1890, 3 plats were annually fertilized as follows: One with 10 cords per acre of cow manure, another with 13½ cords of hog manure, and another with 1,700 lbs. of a commercial fertilizer; a fourth received no fertilizer. Tabulated data are given for the gross yield and the yield of dry matter for 1895, the relative yield of dry matter for 6 years, yield of food ingredients in 1895, the percentage composition of the field-cured maize, kernels, and stover for each plat, the loss or gain in soil fertility after 8 years' manuring and cropping with Indian corn, and the yield of dry matter and shelled corn for 8 years, and composition of dry matter.

The following table shows the results of 8 years' cropping and manuring:

Gain or loss of soil fertility per acre by 8 years' manuring and cropping with Indian corn.

Treatment of soil.	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*
Cow manure	+1,117.9	+ 788.1	+799.1
Hog manure	+1,879.8	+3,446.0	+ 63.9
Chemical fertilizers	+ 520.2	+ 971.6	+177.4
No fertilizer	— 316.6	+ 53.8	— 66.0

Taking the plats in the order given in the table, the first receives annually about 3,207 lbs., the second about 5,440 lbs., and the third about 200 lbs. of organic matter.

The author states that "excess of nitrogen has not made the crop 'run to leaves,' nor has deficiency of plant food strikingly affected the relative proportion of ears and stalks."

During 6 years the first and second plats (cow manure and hog manure) have yielded on the average the same amount of water-free crop, the third plat (chemical fertilizers) has yielded more than eight-tenths as much, and the fourth plat (potash) between five and six tenths as much as the first two. There was a general falling off in the yield of all the plats during 5 years.

As to food ingredients, the crop both of kernels and stalks on the first 2 plats has been practically identical as regards chemical composition. The kernels of the crop on the third plat contained somewhat less mineral matter and fat and about 0.5 per cent less protein than the crops on the first 2, with correspondingly more nitrogen-free extract. The kernels in the crop on the plat not manured had 2.3 per cent less proteids than the first 2 plats, somewhat less ash and fats, but more fiber and nitrogen-free extract.

Mixed forage crops, C. A. GOESSMANN (*Massachusetts Hatch. Sta. Rpt. 1895, pp. 288–293*).—The following mixtures were grown on well-manured land: Vetch and oats; vetch and barley; oats, vetch, and horsebean; and oats and lentils. The yields are tabulated and analyses (food constituents) of all the mixtures are given. The author concludes that these crops compare favorably in value with clover hay.

Fertilizer experiments on oats, C. A. GOESSMANN (*Massachusetts Hatch. Sta. Rpt. 1896, pp. 278–288*).—This is a continuation of previous work published in the Annual Report of the State Station for 1894 (E. S. R., 7, p. 298). In a preface the author reviews his previous work in this line. On 11 tenth-acre plats a uniform application per acre was made of potash and phosphoric acid, and on 8 of the plats 45 lbs. per acre of nitrogen was added in the form of nitrate of soda, sulphate of ammonia, or dried blood. The plats were sown to oats. The yields are tabulated and compared with those in 1893. The author states that the condition of the different plats has apparently not been materially changed by raising soja beans.

The comparative effect of muriate and sulphate of potash on the potato crop, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 117-127, pls. 2*).—This is a report on 4 coöperative experiments carried on in the State under the supervision of the station and 1 in coöperation with the German Kali Works of New York on the effect of potash salts on the potato crop. Nitrogen and phosphoric acid in different forms and potash as sulphate or muriate were used in varying amounts. The tabulated data give the yields, starch content, and analyses of samples of the crops raised.

The author states that the results reported naturally differ with the character of the land, quantity of nitrogen applied, weather conditions, etc.; that in general when muriate of potash was applied the potatoes

contained less starch by 0.5 per cent or less than those raised with sulphate of potash; that muriate may be used where yield alone is sought; that the unfavorable effect of the muriate on the quality of the tubers may probably be lessened by applying it to the land early, even the fall before; and that for growing seed potatoes or those of extra quality the sulphate should be used.

Observations on the agricultural chemistry of sugar cane, T. L. PHIPSON (*Barbados Bot. Sta. Misc. Bul. 7, pp. 1–9*).—This is a popular article treating of the demands that plants in general, and particularly sugar cane, make on the soil. Analyses are given of 12 samples of soil from the West Indies and 1 from Queensland. With reference to lime in soils for growing cane the author says:

"When the quantity of lime has diminished so much by prolonged culture as to be present to the extent of only 0.1 per cent, and then only one-third that of the magnesia present (knowing that in the origin the lime was not only equal to but higher than the magnesia), we may rest assured that the crops of cane on this soil will fall off year by year, and that the most careful system of manuring will be necessary to place it again in its former lucrative condition.

"Such a state of things actually exists over a very considerable portion of British Guiana and Barbados."

Stable manure is considered the best of all for cane. The mixing of acid superphosphates with Peruvian guano and cane ash is recommended for cane soils. The application of sulphate of ammonia is advised only when accompanied by a relatively larger quantity of other manures. The author says:

"There are, indeed, 3 special agricultural difficulties in the direct path of the cane grower in the West Indies. The first is that he is dealing almost everywhere with a stiff clay soil, difficult to work even were labor more plentiful than it is; the second is a remarkable deficiency of lime in many districts; and the third is the very imperfect nature of the manures hitherto imported, and the implicit faith placed in the restoration of the begass ashes."

Report of the results obtained with sugar cane on the experimental fields at Dodd's Reformatory, 1895, J. P. D'ALBUQUERQUE (*Barbados: 1896, pp. 13*).—The fertilizer experiments were arranged to show the effects on the sugar cane of applications of nitrogen, phosphoric acid, and potash in different forms and proportions and at different times. The element tested was in each case combined with the other two, so that a complete fertilizer was used. Applications were made in January and July. The cane was planted in December on 26 plats about one-twentieth of an acre in size and was harvested in April. Tabulated data are given for each group of tests. For nitrogen the highest yield was obtained with the application of 15 lbs. per acre in January and 25 lbs. in July, in the form of ammonium sulphate, and the juice was distinctly richer than in cane from the dried-blood plats. For phosphoric acid 100 lbs. in the form of basic slag gave best results. For potash 100 lbs. gave the highest yield. Applying potash, part early and part late, gave better results than when all was applied early.

A test was made of 12 varieties. Caledonian Queen, Striped Singapore, and Seedling 27 gave highest yields.

Experiments in growing tobacco with different fertilizers in 1894, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 128–145*).—This is a continuation of work published in the Annual Report of the station for 1894 (E. S. R., 7, p. 207). The results are given of an examination of the fermented leaves grown in 1894, also the report of an expert relating to the quality of 29 lots. Tabulated data show the fire-holding capacity of the different lots, and the effect of fertilizers on the quality and quantity of tobacco is discussed.

The fire-holding capacity of the leaf was increased in every case by fermentation, and the tendency to char was not always associated with small fire-holding capacity.

The quality of the leaf raised on land fertilized with cotton-seed meal was somewhat better than when castor pomace was used. Nitrate of soda was injurious to the quality of the wrappers. The total yield and the percentage of wrappers was smallest with applications of stable manure, but the quality was best. As to potash fertilizers, the largest yield of wrappers was with applications of double sulphate of potash and magnesia, followed by the same with lime, by carbonate of potash, and by wood ashes.

Experiments in growing tobacco with different fertilizers in 1895, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 146–156*).—This is a continuation of work published in the Annual Report of the station for 1894 (E. S. R., 7, p. 208). Meteorological data for the season are given, including temperature of the air and soil; also the water content of the soil from daily determinations from June 17 to August 12.

Cotton-seed meal, cotton-hull ashes, linseed meal, castor pomace, nitrate of soda, double sulphate of potash and magnesia, carbonate of potash, double carbonate of potash and magnesia, dry ground fish, tobacco stems, wood ashes, and several brands of fertilizers were tested in various combinations, and stable manure alone. The yields of unfermented tobacco and the comparative fire-holding capacity of the tobacco grown on the different plats are tabulated and briefly discussed. In the gross yield of cured leaf and of wrapper leaf, castor pomace was superior to cotton-seed meal. Where one-half the nitrogen in an application of 210 lbs. of nitrogen in the form of castor pomace was replaced by nitrogen in nitrate of soda, the total yield of wrapper leaf was greater.

As to potash fertilizers, the largest gross yields followed applications of high-grade sulphate, both with and without lime. The largest yield of wrappers was from plats manured with carbonate of potash and the double sulphate of potash and magnesia. The fire-holding capacity was least in tobacco manured with high-grade sulphate, followed by that fertilized with low-grade sulphate. The plats dressed with fish and nitrate of soda, fish and double sulphate of potash, and with stable manure gave the smallest yields.

Analyses of parts of tobacco plant at different stages of growth, R. J. DAVIDSON (*Virginia Sta. Bul. 50, pp. 35–52*).—Analyses of tobacco seed are given for 10 varieties; and for 3 varieties analyses are tabulated for the whole plant at the time of transplanting, for several parts of the plant at the time of cutting, and for leaf and stalk when partly and completely cured. The most variable constituents in the seeds were sulphuric acid and chlorin. Nearly one-half of the ash of the young plants consisted of potash, amounting to 3 times the content of lime. Of the analyses of the leaf at 4 stages and of the whole plant at 3 stages the author says:

"The percentage of ash is about the same at the 4 stages, increasing slightly from topping until cured. The nitrogen is nearly 1 per cent higher at topping. The phosphoric acid shows very little change, being a little higher at time of topping. The potash was highest at time of topping and lowest at the curing state. The soda was a little lower at topping than at any other time. The lime was highest at the cured stage and lowest at the time of topping. The potash was highest when the lime was lowest. The magnesia is increased a little in the last 2 stages. The sulphuric acid and chlorin are also increased slightly in the cured state. . . .

"It appears that the plant taken from the plant bed contains, in the air-dried state, nearly 3 per cent of nitrogen, nearly 1 per cent of phosphoric acid, over 8 per cent of potash, and about 2½ per cent of lime.

"Taken at the time of topping it contains about 3 per cent of nitrogen, one-third of 1 per cent of phosphoric acid, about 4 per cent of potash, and over 2 per cent of lime. Taken at time of cutting it contains nearly 3 per cent of nitrogen, one-third of 1 per cent of phosphoric acid, nearly 3½ per cent of potash, and over 3½ per cent of lime."

Analyses of different grades of manufacturing tobacco, R. J. DAVIDSON (*Virginia Sta. Bul. 51, pp. 55–62*).—The tabulated data in this bulletin include the nitrogen content of 27 samples of dried tobacco leaves, and detailed analyses showing the ash constituents of the dried leaves and the ash of leaves in 27 samples. These analyses embrace the following tobaccos: Low-grade sun-cured, sun-cured manufacturing, high-grade sun-cured, high-grade bright flue-cured, low-grade bright flue-cured, continental, English shipping, and shipping tobacco from 7 counties in Virginia, 1 in West Virginia, and 3 in North Carolina, and shipping and dark snuff tobacco from the Virginia Department of Agriculture. The samples were from the crops of 1890 and 1891. In the sun-cured tobacco the crop of 1891 in one county contained about 1½ times as much potash, nearly twice as much sulphuric acid, and $\frac{1}{6}$ more lime than that of 1890.

"Comparing the 2 grades of flue-cured which were grown in different counties and in different years, we find that the ash is about the same, and in case of the nitrogen, phosphoric acid, potash, magnesia, and sulphuric acid, the low grade contains about twice as much of each of these ingredients as the high grade. The soda is over 6 times as much as in the low grade, the chlorin is about the same, but the insoluble matter in the high grade is 6 times as much as in the low."

In one county the potash in the crop of 1891 was about 1½ times that of 1890, the magnesia and chlorin nearly twice as much, and the insoluble matter about $\frac{1}{5}$ as much. The analyses of manufacturing tobacco

grown in Virginia agreed very well in their ash content except in one county, where it was much lower. The potash did not agree except in 1 or 2 cases. The lime content varied considerably in all cases, and in chlorin and in insoluble matter there was very little agreement. The shipping tobaccos from the Virginia Department of Agriculture contained about ⅓ more potash, about ⅓ less lime, and about 4 times as much chlorin as the other.

In the samples from West Virginia and North Carolina the ash constituents agreed fairly well; the chlorin varied considerably, ranging in the ash from 2.22 to 8.08 per cent. The percentage of ash, nitrogen, and potash was higher and that of lime much lower in the samples from West Virginia than in those from North Carolina.

Percentage of nicotin in tobacco, R. J. DAVIDSON (*Virginia Sta. Bul. 52, pp. 67–72*).—The percentage of nicotin is given for 3 varieties of tobacco at 5 stages of growth—in the plant bed, at topping, at cutting, partly cured, and cured; also in 21 samples of different grades of manufacturing tobacco grown in different counties of Virginia, West Virginia, and North Carolina, including in some cases the crops of different years. The data are tabulated.

Comparing the varieties Burley, Prior, and Oronoko, "we see that in the case of the plant taken from the plant bed there is very little difference [in the nicotin content]. At time of topping, in case of the leaf, the agreement is very close. . . . In the stalk the agreement is not so close, the Burley containing about twice as much as the Prior, and nearly three times as much as the Oronoko. In the root the difference is very slight. . . . At time of cutting the leaf does not show the same agreement except in case of the Pryor and Oronoko, when it agrees fairly well, the Burley being lowest, over 0.5 per cent less than the Oronoko and over 1 per cent less than the Prior. The percentages in the stalk agree much better at this time, being very nearly the same in the 3 varieties."

Among the different grades of manufacturing tobacco the author states that the light tobacco contained the lowest and the dark the highest percentage of nicotin; it ranged from 1.54 in high-grade bright flue cured to 5.56 in English shipping.

A comparison of phosphatic slag and nitrate of soda with ground bone on oats and corn, C. A. GOESSMANN (*Massachusetts Hatch Sta. Rpt. 1895, pp. 308–310*).—This is a continuation of work published in the Annual Report of the State Station for 1894 (E. S. R., 7, p. 291). Two plats were used, 1 and 1.8 acres in extent. One received fine ground bone, the other phosphatic slag, and both muriate of potash.

In 1894 one was sown to oats and the other to corn; the order was reversed in 1895. The following table contains the summary of the yields per acre of both crops:

Summary of yields for 1895.

	Bone and muriate of potash.	Phosphatic slag, nitrate of soda, and muriate of potash.
	Pounds.	*Pounds.*
Oats, hay	3,580	5,134
Corn, ears [1]	3,410	4,231
Corn, stover [2]	2,900	3,091

[1] Moisture, 28 per cent. [2] Moisture, 19.1 per cent when harvested.

The author concludes that for two successive seasons phosphatic slag used in connection with nitrate of soda has been a very efficient substitute for ground bone.

Field experiments with fertilizers, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1895, pp. 101–110*).—These consisted of special nitrogen experiments on corn, cowpeas, and soja beans, and soil tests at the station and on one other farm.

Special nitrogen experiments (pp. 101–107).—May 30, uniform applications of dissolved bone black and muriate of potash were made on 8 fiftieth-acre plats, to 7 of which nitrate of soda or sulphate of ammonia in varying amounts were also added. Two plats served as checks. May 31, 2 varieties of corn, differing considerably in content of protein, were planted on the plats in check rows 3 ft. each way. The data are tabulated.

The author states that there was a marked increase in the yield on the nitrogenous plats over the plat to which only mineral fertilizers were used, and that the latter gave but slight increase over the check plats.

On a like series of plats similarly fertilized cowpeas were planted in 3-foot drills May 31. The yields are tabulated. Applications of nitrogen did not increase the yield. The author concludes that the crop can be readily grown on soils of moderate fertility without the use of nitrogenous fertilizers.

Two series of plats similar to those upon which the corn and cowpeas were grown were planted to soja beans. Soil on which soja beans had grown the previous year was sprinkled over one series of plats. The results are tabulated. But few tubercles were found on the inoculated plats and none on the others; and there was no material difference in the yields attributable to this treatment.

Soil-test experiment (pp. 107–109).—The results are given for the sixth year of a rotation soil-test experiment on the station farm. The crops in previous years had been corn, potatoes, oats, cowpeas, and corn. Potatoes were grown in the present case. Two half acres were divided

into 10 plats each, with spaces between adjacent plats. The usual fertilizers and combinations were used. The potatoes were attacked by blight in July, and the yields, which are tabulated, were "quite light on all of the plats." Plants on plats fertilized with potash withstood the blight best. The yields on these plats during the 6 years of the test are tabulated.

Soil test with fertilizers on corn (p. 110).—A coöperative fertilizer experiment with corn was continued on the farm belonging to the Ekonk Grange. Previous work in this line was published in the Annual Report of the station for 1894 (E. S. R., 7, p. 571). Tabulated data are given for the kind, amount, and cost of fertilizers, yield of shelled corn, percentage of dry matter in shelled corn, weight of shelled corn per bushel, proportion of good and poor corn, and weight of stover per acre.

A report of progress is made in experiments in green manuring with different kinds of leguminous crops for the purpose of studying their value for improving wornout, sandy lands. Owing to the dry season in 1895 the results were inconclusive. So far cowpeas have given the best results.

Field experiments with different commercial fertilizers, C. A. GOESSMANN (*Massachusetts Hatch Sta. Rpt. 1895, pp. 294–298*).—The results of experiments begun in 1890 (E. S. R., 7, p. 292) with dissolved bone black, South Carolina phosphate, Florida phosphate, Mona guano, and phosphatic slag are reviewed, and the data for 1895, with rye as the crop, are reported. A summary is given of the yields of crops from 1890 to 1895, inclusive, and a tabulated statement of the phosphoric acid applied to and removed from the field.

The author states that the amount of phosphoric acid in the soil at the close of the season in 1895 was lowest in the plat where dissolved bone black was applied.

Report of the agriculturist, W. P. BROOKS (*Massachusetts Hatch Sta. Rpt. 1895, pp. 177–208*).—Coöperative experiments with fertilizers on corn were carried out on 3 farms in the State, and the results in two cases are reported, in which the yields were larger where either muriate of potash or nitrate of soda were applied.

At the station the yield of rye where barnyard manure or complete commercial fertilizers were employed was increased, and white mustard sown July 31, after the rye, made the largest growth on plats that had previously received applications of phosphates.

In a comparison on 4 quarter-acre plats of muriate and sulphate of potash as a source of potash for potatoes the fertilizers were applied broadcast and in the drill. The author states that the plats receiving the sulphate of potash have given the largest yield in every instance except one, and the average difference in favor of drill application amounted to 22.1 bu. of merchantable potatoes per acre.

The difference in yield between Maine-grown seed potatoes and seed grown at the station from Maine-grown seed of the year previous was 36.5 bu. in favor of the former.

A test was made of 65 varieties of potatoes in which 3 lbs. of each variety of seed was planted. Detailed results are not given, as the test is to be continued.

An application of 6 cords of barnyard manure was compared with one of 4 cords of manure and 160 lbs. of muriate of potash on 4 quarter-acre plats planted to corn. The average difference in yield in favor of barnyard manure alone was not sufficient to cover its extra cost. In another experiment with corn a special fertilizer furnishing the ingredients found in 1,200 lbs. of commercial fertilizers of average composition, amounting in the case of potash to 108 lbs. of muriate per acre, was compared with another complete fertilizer supplying muriate of potash at the rate of 300 lbs. per acre. The yields in favor of the special fertilizer were 2.2 bu. more of grain and 498 lbs. less of stover per acre, but the net financial gain was $3.62 per acre in favor of the fertilizer furnishing the larger amount of potash.

Corn was planted in 3½-foot rows in hills containing 3 plants each at distances of 3 ft. in the row; also in drills, single plants being grown at a distance of 1 ft. in the row. Averaging 2 experiments the drill system produced the more valuable total crop.

Corn grown where white mustard had been sown in the standing corn in July of the previous year, and plowed under in the fall, yielded 452 lbs. more stover and 5.4 bu. more grain per acre than the plats without green manure.

In trials of forage crops the Japanese millet (*Panicum crus-galli*) grown on well-manured soil of moderate fertility yielded at the rate of 11,297 lbs. of straw and 66.7 bu. of seed per acre. This millet grew to an average height of about 6 ft., and produced from 12 to 15 tons of green forage per acre. When cured for hay, it yielded on good land 6 tons per acre. *Panicum miliaceum*, which the author designates as Japanese panicle millet, sown on well-fertilized soil, yielded at the rate of 5,856 lbs. of straw and 34.1 bu. of seed per acre. *Panicum italicum* yielded at the rate of 3,836 lbs. of straw and 66.4 bu. of seed. The author regards *Panicum crus-galli* as the most valuable of the three.

A variety test was made with 27 varieties of millet grown on a small scale. The author states that pearl millets are too late to mature seed at the station. Japanese millet (*Panicum italicum*) excelled both the Golden and Golden Wonder.

The Early White, Medium Black, and Medium Green varieties of soja beans were grown. The first yielded at the rate of 18.25 bu. and the second and third 14 bu. each of seed per acre. The author regards the last-mentioned variety as a very valuable one for fodder, either for feeding green or for the silo.

Tabulated analyses and food constituents per acre are given of Medium Green soja bean and Longfellow corn fodder.

Notes are given on the following miscellaneous crops: *Cytisus proliferous albus*, yellow millo maize, white dent corn, spring wheat, black barley, horse bean, sachaline, flat pea, and mummy field pea,

Three kinds of hay caps were tried at the station: Symmes' paper-board, oiled cotton, and cotton treated with tannin. The first is held in place by its weight and the others are fastened by pins attached to cords at the corners. In every trial the use of the cap was very beneficial, and the author considers the paper cap in some respects superior to the other two.

Notes are given on an experiment in warming a stable for cows and on poultry feeding, which are abstracted elsewhere.

Natural history and culture of brewing barley, A. VON LIEBENBERG (*Zur Naturgeschichte und Cultur der Braugerste. Wien: Wilhelm Frick, 1897, pp. 52*).

Experiments with maize at the Richmond River Experiment Farm, G. M. MCKEOWN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 8, pp. 533, 534*).—Green manuring with field peas gave good results. The crops suffered from borers, rust, beetles (*Monalepta rosea*), and parrots. The yields ranged from 23 to 53¼ bu. per acre, the leading varieties being Red Hogan, Large Yellow Flint, Chester County Mammoth, and Large Yellow Dent.

Field experiments with fertilizers on corn, potatoes, and tobacco (*Kentucky Sta. Rpt. 1895, pp. 39–53*).—Reprinted from Bulletin 55 of the station (E. S. R., 7, p. 201).

A reported new variety of cotton, A. PHENIS (*The Southern States, 1896, Nov., pp. 355–359, 372, figs. 2*).

The manuring of cotton, L. GRANDEAU (*Ann. Sci. Agron., ser. 2, 1896, II, No. 2, pp. 253–264, figs. 3*).—This is principally a review of the work of the Alabama Station.

Cotton, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 23, 24*).—A eprint from Bulletin 31 of the station (E. S. R., 6, p. 898).

Cowpeas, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 11–16*).—A reprint from Bulletin 31 of the station (E. S. R., 6, p. 898).

Vegetable textiles of the French Colonies, H. LE COMTE (*Ann. Sci. Agron., ser. 2, 1896, II, No. 1, pp. 1–112*).—This is a report on cotton, jute, malvaceous fiber plants, Sida, Papilionaceæ, Urticaceæ, Thymeleaceæ, Abaca (or manila hemp), Liliaceæ (*Phormia tenax* and Yucca), Sanseviera, Bromeliaceæ (Ananas and Tillandsia), Amaryllidæ (Agave, Fourcroya, and palms), Raphia, and Gramineæ.

Forage plants, C. L. NEWMAN (*Arkansas Sta. Rpt. 1895, pp. 126–128*).—Reprinted from Bulletin 34 of the station (E. S. R., 7, p. 121).

Forage plants at Wagga Wagga, G. VALDER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 9, pp. 602–608, figs. 5*).—Notes are given on the culture of lucern, tagosaste (*Cytisus proliferus albus*), Bokhara clover, *Lathyrus sylvestris*, sachaline, prickly comfrey, serradella, and Jersey tree kale.

Tagosaste is spoken of as a most valuable plant in time of drought, but one not to be recommended on a large scale as a forage plant. Planted 4 ft. each way, in 12 months the plants were 10 to 12 ft. high. The author considers it inferior to the saltbush (*Atriplix nummularia*).

Sachaline, prickly comfrey, and serradella are not recommended. The Jersey tree kale is considered a valuable fodder plant.

Experiments with fodders and pasture grasses at the Richmond River Experiment Farm, G. M. MCKEOWN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 8, pp. 528–532*).—The season was very dry and hot. The following species and varieties were grown: Sorghum, millet, teosinte, lucern, tagosaste (*Cytisus proliferus albus*), alfalfa, clovers (red, crimson, alsike, Dutch, Japanese, Egyptian, and Bokhara), sulla, serradella, trefoil, flat pea, hairy vetch, barley, *Paspalum conjugatum*, *P. dilatatum*, *P. pubescens*, Natal redtop (*Trichlæna rosea*), *Panicum plicatum*, guinea grass (*P. maximum*), *P. spectabile*, *P. effusum*, barnyard grass, *Eleusine stricta*, *Setaria macrostachya*, prairie grass (*Bromus unioloides*), smooth brome grass, perennial rye grass, orchard grass, rough-stalked meadow grass, and meadow fescue. The following have resulted in

failure: Tall, hard, and red fescue, timothy, Canada rice, *Leersia hexandra*, wood pea, vernal grass, and meadow foxtail.

Grasses, F. LAMSON-SCRIBNER (*Trans. Mass. Hort. Soc., 1896, I, pp. 134–149*).

Grasses and clovers, R. L. BENNETT (*Arkansas Sta. Rpt. 1895, pp. 160–179*).—A reprint of Bulletin 36 of the station (E. S. R., 7, p. 296).

Experiments with a rotation of manures upon permanent grass lands, meadows, and pastures, C. A. GOESSMANN (*Massachusetts Hatch Sta. Rpt. 1895, pp. 311, 312*).—The yields of hay for 2 cuttings in 1895 are tabulated.

Fertilizer experiments on hemp (*Kentucky Sta. Rpt. 1895, pp. 54, 55*).—Reprinted from Bulletin 55 of the station (E. S. R., 7, p. 201).

Oat experiments (*Kentucky Sta. Rpt. 1895, pp. 84–86*).—Reprinted from Bulletin 57 of the station (E. S. R., 7, p. 758).

Peanuts, C. L. NEWMAN (*Arkansas Sta. Rpt. 1895, pp. 19–23, 124–126*).—Reprinted from Bulletins 31 and 34 of the station (E. S. R., 6, p. 889; 7, p. 117).

Jerusalem artichokes, turnips, and mangel-wurzels, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 24–28*).—A reprint from Bulletin 31 of the station (E. S. R., 6, p. 890).

Sugar cane in South Florida, S. W. CARSON (*Florida Farmer and Fruit Grower, 8 (1896), No. 43, pp. 678, 679*).—A popular article discussing conditions and noting a favorable test.

Progress in the study of the chemistry of tobacco, R. KISSLING (*Chem. Ztg., 20 (1896), No. 74, pp. 715–717*).—A careful review of investigations on this subject during recent years.

Hairy vetch, G. BARBUT (*Prog. Agr. et Vit., 26 (1896), No. 46, pp. 550–556*).

Wheat experiments (*Kentucky Sta. Rpt. 1895, pp. 75–83*).—Reprinted from Bulletin 57 of the station (E. S. R., 7, p. 763).

The improvement of wheat from a commercial and milling standpoint in connection with its chemical and physical properties, A. RICHTER (*Fühling's landw. Ztg., 45 (1896), Nos. 10, pp. 320–326; 11, pp. 353–361; 12, pp. 392–395; 13, pp. 424–429; 15, pp. 491–497; 18, pp. 576–588; 19, pp. 607–623*).—An extended discussion of the subject.

Note on silage, N. MINANGOIN (*Bul. Agr. et Commerce, 1 (1896), No. 1, pp. 29–35*).

Experiments at Borsbeke-lez-Alost, Belgium, P. DE VUYST (*Cultures Spéciales, Borsbeke-lez-Alost, 1896, pp. 12*).—Experiments with fertilizers, tests of varieties, and methods of culture during 1895 and 6 preceding years are summarized. The crops experimented on during this period include wheat, oats, rye, mixed cereals (maslin), potatoes, beets, turnips, flax, clover, and meadow grasses.

HORTICULTURE.

On the use of commercial fertilizers for forcing-house crops: Tomatoes, E. H. JENKINS and W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 75–90*).—The object of this series of trials was "to determine with all possible accuracy how much plant food various forcing-house crops take from the soil during their growth, and whether commercial fertilizers can be used instead of stable manure, wholly or in part, to supply this plant food."

In this first experiment the nitrogen requirement and nitrogen supply of tomatoes grown under glass were studied.

Five plats on a forcing-house bench, each containing 13.87 sq. ft. and about 8 in. deep, were filled with an artificial soil consisting of anthracite coal ashes and peat moss with a small amount of carbonate of lime to make the mixture alkaline.

One plat received no fertilizers, but the remaining 4 were supplied

with phosphoric acid in the form of dissolved bone black and potash as muriate at the rate of 8.1 and 29.3 gm., respectively, per plat, and with nitrogen as nitrate of soda at the varying rates of 10.9, 18.2, 25.4, and 32.7 gm.

Two plants of each of the varieties Ignotum, Acme, and Dwarf Champion were planted in each of these 5 plats about January 1, at which time they were somewhat "leggy," but developed into fairly normal, thrifty specimens. They were trained upon the "single-stem" system, and the flowers were artificially pollinated. By January 8 the plants on the unfertilized plat were lighter in color than the others, and this difference increased through the season. The first fruits were harvested February 27. An accurate record of each plant was kept, with the weight and measure of each tomato produced and notes regarding form, color, etc.

Fruits taken from the plants when bearing freely, the vines and leaves at the close of the experiment, and trimmings removed during the growing season were all analyzed for fertilizer ingredients; but the roots could not be readily separated from the ashes and peat, so they were not considered.

Tables are given showing for each plat the fertilizers applied, yield of each variety, average number and weight of fruits per plant, number of double fruits, number and percentage of perfect-shaped fruits, and average yield per square foot of bench area; the composition of vines, leaves, and fruits; and the quantities of fertilizer ingredients taken from each plat in fruit and vines. The data are discussed from both the chemical and horticultural standpoints.

A rough comparison is made between the plants grown on the artificial soil and others grown on natural soil in the same forcing house, but under slightly different conditions. It is thought that the artificial soil contained very little nitrogen available to the tomatoes, as the 6 plants grown on the plat without fertilizer contained only half a gram of nitrogen, part of which came from the young plants and the soil adhering to their roots when transplanted. The authors also believe that the quantities of phosphoric acid and potash applied were not sufficient for a maximum crop, but that the plants were able to obtain some phosphoric acid and considerable potash from the artificial soil. The following table shows the amount of these substances applied in the fertilizer and taken from each plat in the crop:

Phosphoric acid and potash applied in fertilizer and removed by tomato crop on artificial soil.

Plat.	Phosphoric acid.		Potash.	
	Applied.	Removed.	Applied.	Removed.
	Grams.	*Grams.*	*Grams.*	*Grams.*
5	8.14	5.50	29.30	26.85
6	8.14	6.76	29.30	39.55
7	8.14	7.76	29.30	50.16
8	8.14	8.95	29.30	46.46

The 4 plats with regularly increased amounts of nitrogen show an increasing yield of fruit, of the average number of fruits per plant, and of nitrogen, phosphoric acid, and potash in the crop, as shown in following table:

Fruit grown and fertilizer constituents in fruit and vines of tomatoes grown on artificial soil with varying amounts of nitrogen.

Plat.	Amount of nitrogen added.	Weight of fruit.	Average number of fruits per plant.	Average weight of a single fruit.	Yields of crops in— Nitrogen.	Phosphoric acid.	Potash.
	Grams.	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
4	0.0	316	1.0	50.8	0.55	0.95	2.20
5	10.9	4,840	8.8	99.6	6.34	5.50	26.85
6	18.2	8,331	12.6	112.5	11.25	6.76	39.55
7	25.4	10,505	17.0	103.1	17.01	7.76	50.16
8	32.7	12,522	21.0	99.1	23.23	8.95	46.46

In comparison of fruit grown on artificial and natural soil, the authors consider only the 2 plats containing the larger amounts of nitrogen, as the others had by no means an adequate supply of nitrogen. It is thought probable that those considered did not have a full supply of any of the fertilizing ingredients, as they grew and fruited more rapidly than those in natural soil, then suddenly stopped growth and bearing and appeared dead, but upon cutting back and applying more fertilizers made a new and vigorous growth and fruited again. The plants in natural soil continued to bear until the following July, but the authors think there is no profit in forcing-house tomatoes after April 15.

The following table shows the average yield of fruit per plant and per square foot of bench area for the plants on natural and artificial soil:

Average yield of tomatoes on natural and artificial soil.

	Yield per plant.	Number of fruits per plant.	Weight of fruits.	Yield per square foot.
	Grams.		*Grams.*	*Grams.*
Artificial soil to April 17	2,087	21.0	99.1	904
Natural soil:				
To April 17	976	10.4	91.7	847
To July 16	1,820	22.7	82.4	1,583

The authors draw the following conclusions:

"(1) A forcing-house tomato crop yielding about 2 lbs. of fruit for each square foot of bench room takes in the vines and fruit, for every 100 sq. ft. of bench space, not less than:

	Grams.		Pounds.	Ounces.
Nitrogen	168	Equivalent to nitrate of soda	2	5
Phosphoric acid	65	" " dissolved bone black	0	13
Potash	362	" " muriate of potash	1	9

"Of this from a fourth to a fifth only is in the vines.

"(2) To enable the plants to get these fertilizer elements as required, there should be a large excess of them in the soil, perhaps double the quantity given above.

"(3) Every 100 lbs. of tomato fruit takes from the soil approximately:

	Ounces.		Ounces.
Nitrogen	2.2	Equivalent to nitrate of soda	14
Phosphoric acid	0.9	" " dissolved bone black	5
Potash	4.6	" " muriate of potash	10

"(4) It is possible to grow a crop of forcing-house tomatoes, amounting to 2 or more pounds per square foot of bench space, perfectly normal in size, color, taste, and chemical composition, by the aid of commercial fertilizers alone, and in soil composed of coal ashes and peat."

On the chemical composition of lettuce grown in the forcing house, E. H. JENKINS and W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 93–95*).—An experiment similar to the above with tomatoes was made with lettuce, but extended notice is to be deferred until further tests are completed. Some data which are thought to have independent value are given.

Beds containing 11.6 sq. ft. were filled with a mixture of 190 lbs. anthracite coal ashes and 10 lbs. peat moss, and plants of Simpson White Seeded Tennis Ball lettuce were set 8 in. apart each way. At harvest the lettuce heads were cut close to the surface of the soil, weighed, and dried for analysis, and the roots separated as well as possible from the soil and analyzed. Tables show the amounts of fertilizer applied and crop harvested, composition of fresh plants, and fertilizer ingredients taken up by crops. The authors give the following conclusions:

"(1) Lettuce of good quality can be grown under glass in an artificial soil such as we have described with the use of commercial fertilizers.

"We are not prepared to say at present that its quality is as good as the best lettuce grown in rich, natural soil.

"(2) A crop of forcing-house lettuce raised as above described takes from the soil in roots and heads, per 1,000 heads, not less than:

	Grams.		Pounds.	Ounces.	
Nitrogen	282.6	Equivalent to	3	15	nitrate of soda.
Phosphoric acid	87.7	" "	1	2	dissolved bone black.
Potash	621.0	" "	2	10	muriate of potash.

"(3) To supply this plant food to the soil under the conditions of our experiment, it was necessary to add to the soil the following quantities of fertilizers per 1,000 plants, or per 387 sq. ft., the area used in our experiment for 1,000 plants:

Fertilizers required by 1,000 lettuce plants.

	Weight.		Cost.
	Lbs.	*Ozs.*	*Cents.*
Nitrate of soda	9	13	25
Dissolved bone black	2	15	4
Muriate of potash	3	8	7
Total			36

The use of artificial soil and commercial fertilizers in forcing houses, E. H. JENKINS and W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 91, 92*).—In connection with the experiment with tomatoes

described above (p. 402), some points are noted in favor of artificial soil of coal ashes and peat moss as a substitute for natural soil, but the experience is considered too limited to afford conclusive results.

This experiment tended to show that with artificial soil the benches can be filled at less cost, that plants are not so liable to attacks of root insects or nematodes, that the crop will mature earlier, and that the benches do not decay as rapidly.

Field experiments with commercial fertilizers on garden crops, C. A. GOESSMANN (*Massachusetts Hatch Sta. Rpt. 1895, pp. 299–307*).—A general résumé is given of experiments along this line begun by the State Station in 1891 and described in the Annual Reports of that station for 1893 and 1894 (E. S. R., 6, p. 296; 7, p. 302). The crops upon which different forms of nitrogen and potash were tested in 1895 were onions, sweet corn, beans, and tomatoes. Notes and tabulated yields per plat are given for each crop, and summaries for crops raised for several years in succession.

The author draws the following conclusions from the summarized data:

"Sulphate of potash in connection with nitrate of soda has given in every case but one (onions) the best results.

"Nitrate of soda as nitrogen source has yielded in every case, without reference to the form of potash, the best returns.

"Sulphate of ammonia as nitrogen source, in connection with muriate of potash as potash source, has given the least satisfactory returns.

"The influence of the difference in the general character of the weather, whether normal or dry, during succeeding seasons on the yield of crops has been greater than that of the different fertilizers used upon different plats during the same season."

The nitrogen and mineral matters in a peach crop, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 157, 158*).—Tables are given showing the nitrogen and ash in the air-dried flesh and stones of 2,000 gm. of peaches, and the proximate constituents of the ash. The pulp of the fruit contains the greater part of both nitrogen and mineral matters, only one-fourth of the nitrogen and one-tenth of the ash elements being contained in the stones.

From the data given it is estimated that the following amounts of nitrogen and ash ingredients are removed by a peach crop of 390 baskets per acre:

Nitrogen and ash ingredients removed per acre by peach crop.

	Pounds.
Nitrogen	19.7
Potash	21.9
Soda	1.2
Lime	1.0
Magnesia	1.0
Iron oxid	.4
Phosphoric acid	4.2
Sulphuric acid	1.0
Chlorin	.4

On fertilizing orchards, S. W. JOHNSON (*Connecticut State Sta. Rpt. 1895, pp. 159–161*).—A general discussion of the subject is given, based upon data obtained from the analysis of peaches (see p. 406). The author thinks the figures given indicate that an average crop of peaches requires about 20 lbs. of nitrogen, 22 lbs. of potash, and 5 lbs. of phosphoric acid per acre; and a maximum crop about 27 lbs., 30 lbs., and 7 lbs., respectively, of these ingredients; but considers that the growth of young wood, the limited amount of soil accessible to the assimilating rootlets, the change in availability of fertilizers in the soil, and the loss by leaching must all be taken into account; and that the amount of any fertilizer ingredient necessary can be known only by experience or experiment.

Lime is thought to be a very necessary addition to many soils, as it is a chief ingredient in the ash of the trees, though scarcely noticeable in the fruit.

Horticulture: Results for 1895, W. C. STUBBS, F. H. BURNETTE, and E. WATSON (*Louisiana Stas. Bul. 42, pp. 1503–1544*).—This bulletin contains general remarks on truck growing in the State and tabulated data and notes on the following crops grown at the stations:

Vegetables—asparagus, snap beans, Lima beans, beets, cabbages, cauliflowers, carrots, sweet corn, cucumbers, eggplants, potatoes, sweet potatoes, kale, kohl-rabi, leeks, lettuce, cantaloupes, okra, peppers, peas, radishes, ruta-bagas, squashes, tomatoes, turnips, and watermelons; *Fruits*—apples, nectarines, figs, grapes, pears, peaches, Japanese persimmons, plums, quinces, oranges, grape fruits, raspberries, strawberries, Japanese wineberry, and goumi.

Seeds of the same variety of nearly every vegetable tested were obtained from Northern and from Southern seedsmen and comparison made to ascertain if there was any advantage in the use of Northern grown seeds. The sources of the seed are noted in the table for each crop, but no conclusions are drawn.

The origin of the bean and of its name, H. DAUTHENAY (*Rev. Hort., 68 (1896), No. 18, pp. 432–434*).—Review of a paper by G. Gibault published in *Jour. Soc. Nat. Hort. France*.

The original habitat of the beans (*Wien. illus. Gart. Ztg., 20 (1896), No. 10, pp. 354–356*).

Intensive cultivation of celery, W. H. JENKINS (*Amer. Gard., 17 (1896), No. 103, p. 786, fig. 1*).

Culture of the sea kale (Crambe maritima), N. SCHNEIDER (*Rev. Hort., 68 (1896), Nos. 18, pp. 436–439; 19, pp. 458–461, fig. 1*).

Mushrooms, edible and poisonous, W. C. BATES (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 169–187*).

Some truths about toadstools, C. MCILVAINE (*Forester, 2 (1896), No. 5, pp. 79–81*).—Popular notes are given for the recognition of edible mushrooms.

Edible fungi, E. F. WALLIS (*Nat. Hist. Jour., 20 (1896), No. 179, pp. 124–127*).—Popular notes are given of a number of edible mushrooms.

Sweet potatoes, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 16–19*).—Reprinted from Bulletin 31 of the station (E. S. R., 6, p. 902).

Pollination and reproduction of Lycopersicum esculentum, B. FINK (*Minnesota Bot. Studies, Bul. 9, pt. 9, pp. 636-643*).

Vegetable gardening and tests of vegetables, C. L. NEWMAN (*Arkansas Sta. Rpt. 1895, pp. 99-124*).—Reprinted from Bulletin 34 of the station (E. S. R., 7, p. 123).

Notes on vegetables, C. W. MATHEWS and A. T. JORDAN (*Kentucky Sta. Rpt. 1895, pp. 3-36*).—A reprint of Bulletin 54 of the station (E. S. R., 7, p. 212).

Hardy garden plants, E. O. ORPET (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 18-29*).

The compost heap for pot culture (*Amer. Gard., 17 (1896), No. 103, pp. 792, 793, fig. 1*).—Directions for making and utilizing compost heaps and compost.

Movable and combination greenhouse benches, W. H. WITTE (*Florists' Exchange, 8 (1896), No. 41, p. 924, figs. 7*).

The Rochelle apple (*Canadian Hort., 19 (1896), No. 12, p. 426*).—Historical notes are given of this new apple, which on account of its far northern origin is thought to be valuable for cold regions.

Six varieties of cider apples, G. HEUZÉ (*Rev. Hort., 68 (1896), No. 16, pp. 376-379, pl. 1*).—Descriptions of the varieties are given, with comparative chemical data relating to their suitability for cider making.

The Vermont apple crop, F. A. WAUGH (*Garden and Forest, 9 (1896), No. 458, p. 488*).

The Claude Blanchet pear, C. MATHIEU (*Gartenflora, 45 (1896), No. 23, pp. 617, 618, pl. 1*).

The Howell pear (*Canadian Hort., 19 (1896), No. 12, p. 411, pl. 1*).

Orange dropping and its causes, C. B. MESSENGER (*California Fruit Grower, 19 (1896), No. 15, p. 281*).

Orientation of young trees in transplanting, A. CHARGUERAUD (*Rev. Hort., 68 (1896), No. 19, pp. 450, 451*).

Suggestions for setting out fruit trees, PERSCKE (*Deut. landw. Presse, 23 (1896), No. 91, p. 809*).

Irrigation for apricot and other fruit trees (*Agl. Jour. Cape Colony, 9 (1896), No. 22, pp. 565, 566*).—Notes are given on the proper time for the application of water.

Manuring orchards, E. B. VOORHEES (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 150-165*).

Passiflora edulis, J. ROBERTS (*Garden, 50 (1896), No. 1305, pp. 414, 415, pl. 1, fig. 1*).—Directions for cultivation of this plant, which is considered valuable both as a decorative climber in conservatories and as a producer of fruit.

Chemistry of the strawberry plant, J. J. WILLIS (*Gard. Chron., ser. 3, 20 (1896), No. 516, pp. 590, 591*).

On the choice of fertilizers for grapevines, L. DEGRULLY (*Prog. Agr. et Vit., 26 (1896), No. 46, pp. 541-543*).

The early Victor grape (*Canadian Hort., 19 (1896), No. 12, p. 418, fig. 1*).

Some new resistant grapes, G. HUSMANN (*California Fruit Grower, 19 (1896), No. 14, pp. 274, 275*).—Notes are given upon 10 varieties.

Thawing frozen fruit (*California Fruit Grower, 19 (1896), No. 14, p. 267*).—Popular directions based on experiments of Müller-Thurgau.

Thawing frozen fruit (*Canadian Hort., 19 (1896), No. 12, p. 419*).

Carbonic acid gas process of fruit shipment unsuccessful (*California Fruit Grower, 19 (1896), No. 9, p. 165*).—An account of two shipments of carload lots of fruit. The fruit was unsalable.

Steaming fruit before evaporating (*California Fruit Grower, 19 (1896), No. 13, p. 241*).

Home grown and American fruit (*Gard. Chron., ser. 3, 20 (1896), No. 518, p. 654*).—The writer comments very favorably upon the general excellence of the American apples found in English markets.

The study of varieties of fruits and vegetables, L. F. KINNEY (*Garden and Forest, 9 (1896), No. 458, p. 482*).

New early chrysanthemums, D. B. CRANE (*Garden, 50 (1896), No. 1294, p. 185*).—Descriptions of 11 French and English varieties.

Fertilizer experiment with chrysanthemums, B. T. GALLOWAY (*Florists' Exchange, 8 (1896), No. 49, p. 1083*).

Comparative merit of different geraniums, H. DAUTHENAY (*Rev. Hort., 68 (1896), No. 17, pp. 410–412*).—A table is given showing classification of 62 varieties with respect to resistance to extremes of wind, drought, and moisture; freedom of flowering, general vigor, and form of flower clusters.

The ash of orchids (*Florists' Exchange, 8 (1896), No. 44, p. 980*).

Stove plants in their native tropics, G. L. GOODALE (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 50–54*).—An illustrated lecture on some tropical plants.

The chemical tripod in floriculture, R. C. KEDZIE (*Florists' Exchange, 8 (1896), No. 35, p. 770*).—A paper presented by the author at the meeting of the Society of American Florists at Cleveland, Ohio, August 20, 1896. The author discusses the general principles underlying the use of fertilizers and suggests the possibility of retarding flower production by the use of nitrogen to stimulate vegetative activity and of hastening the flowering period by the application of superphosphates. An editorial n a later number of the periodical (No. 43, p. 962) suggests work by the stations along this line.

Experiment stations and the florist trade, A. C. TRUE (*Florists' Exchange, 8 (1896), No. 45, p. 1002*).

Ornamental planting for parks and public grounds, W. S. EGERTON (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 119–133*).

Report of horticulturist, S. T. MAYNARD (*Massachusetts Hatch Sta. Rpt. 1895, pp. 213–216*).—Owing to the rearrangement of station work and the almost complete destruction of late crops by a hail storm, the author is able to give only an outline of the work undertaken in this department of the station.

Compilation of analyses of fruits and garden crops, C. A. GOESSMANN and H. D. HASKINS (*Massachusetts Hatch Sta. Rpt. 1895, pp. 346–352*).—Tables show the average percentages of fertilizing constituents and the relative proportions of phosphoric acid, potash, and nitrogen (phosphoric acid being taken as 1) in a large number of fruits and vegetables botanically classified.

SEEDS—WEEDS.

Kansas weeds, III, A. S. HITCHCOCK and J. B. S. NORTON (*Kansas Sta. Bul. 57, pp. 64, pls. 17*).—This bulletin is in continuation of the weed studies begun in Bulletin 50 of the station (E. S. R., 7, p. 407). In the present number a descriptive list is given of all the weeds of Kansas, so far as information was at hand. By means of keys, illustrations, and brief descriptions, the easy identification of almost any weed is rendered possible. The order of arrangement is that of the usual manuals covering that region, and each species is numbered referring to the figure and also to a map showing its distribution by counties throughout the State. In all 209 species are described, illustrated, and their distribution indicated.

Contributions from the seed testing section of Hamburg Botanical Laboratory, O. BURCHARD (*Mittheilungen aus dem Botanischen Laboratorium mit Samen-Prufungsanstalt zu Hamburg, 1897, VI, pp. 14, pl. 1*).—A report is given of the work in the laboratory for the

year ending June 30, 1896. Studies have been made of blue grass seed, 10 species of which are described and figured. The report of seed testing shows an increase of nearly 20 per cent in the number of samples tested and about 21 per cent of increase in the number of tests for purity, germination, etc. The percentages of purity and germinative ability show in most cases an increase over those of the previous year.

A brief report is given on samples of barley bran and oil cakes examined during the year.

Plat experiments with red clover, summer wheat, and several leguminous forage plants are briefly reported.

Seed raising, R. FYFE (*Gard. Chron., ser. 3, 20 (1896), No. 516, p. 602*).—Brief notes are given on seed raising, and the belief that seed from certain portions of the plant are better or truer in character is denied.

Germination of tree seeds, A. C. FORBES (*Gard. Chron., ser., 3, 20 (1896), No. 515, pp. 558, 559*).—Practical notes are given on the germination of various tree seeds.

Investigations of forest seeds by the experiment station at Bonn in the year 1896 (*Deut. landw. Presse, 23 (1896), No. 87, p. 779*).

Seed control: Its aims, methods, and benefits, G. H. HICKS (*Pp. 28*).—An address delivered before the Massachusetts Horticultural Society February 8, 1896.

Tumbling mustard, L. H. DEWEY (*U. S. Dept. Agr., Division of Botany Circular 7, pp. 8, figs. 3*).—Illustrated descriptive notes are given of the tumbling mustard (*Sisymbrium altissimum*), a troublesome introduced weed. The methods of dissemination are described and its distribution shown by means of a map which shows the plant to be widely distributed throughout the northern and eastern United States and Canada. Methods are suggested for its eradication. Tumbling mustard has been proscribed by law in Minnesota.

Brassica juncea, L. H. BAILEY (*Bot. Gaz., 22 (1896), No. 5, p. 401*).—The question is raised whether this weed is a direct importation from the Old World or a spontaneous derivation from gardens, the plant being somewhat cultivated under the names Chinese mustard or brown mustard.

Weed destruction, A. ARNSTADT (*Die Bekämpfung des Unkrautes. Harsleben-Halberstadt: J. Briest, 1896, pp. 43*).

DISEASES OF PLANTS.

Fungus diseases and their treatment, W. C. STURGIS (*Connecticut State Sta. Rpt. 1895, pp. 166–190, pls. 2, tables 2*).

Synopsis.—Notes are given on experiments for the prevention of potato scab, transplanting as a preventive of onion smut, a leaf curl of Japanese plums, and miscellaneous notes on powdery mildew of grapes, a melon disease, plum leaf spot, hollyhock rust, winterkilling of peach trees, and frost injury to pears.

The experiments on the prevention of potato scab reported in the Annual Report of the station for 1894 (E. S. R., 7, p. 219) were continued and their scope somewhat extended. The effect was studied of lime on the prevalence of scab, of treatment of seed planted in infested soil, and of barnyard manure on scab production. In addition the effect of corrosive sublimate on the vitality of sprouted seed potatoes was investigated. In this experiment, although treated for an hour or more, the sprouts are said to have been uninjured and all such plants were fully a week in advance of those from unsprouted seed.

A summary of the experiments for the prevention of the potato scab shows that the addition of lime in small quantities to the soil of the experimental field increased the amount of scab; that the presence of the organism in the soil tends to increase the infection of succeeding crops of potatoes, beets, and turnips, and the treatment of the seed with corrosive sublimate before planting in infested soil is of little avail in preventing scab; and that fresh barnyard manure exhibits less tendency to induce scab than composted manure. The author states that too much stress must not be laid upon this last conclusion, since it is based on a single experiment.

Experiments were conducted on the value of transplanting onions for smut prevention, and although the general results are horticultural rather than mycological the author's summary shows that—

"(1) This method insures a clean crop even upon smutty land.

"(2) Transplanted onions are less liable to the attacks of cutworms than onions sown in the field.

"(3) The crop matures earlier by 3 or 4 weeks.

"(4) The crop is larger by an average of 50 per cent or more with native varieties, and the average increase with large foreign varieties may exceed 100 per cent.

"(5) The individual bulbs are larger and mature more evenly.

"(6) The increase in the size and quality of the crop, the earlier ripening, and the lessened expense incident to the care of the plants after transplanting, offset in a measure the cost and labor of raising and transplanting the seedlings.

"(7) This method may be applied with certain profit wherever it has been the custom to grow onions from sets upon smutty land, or in small quantities for home use or small sales."

A report is given of a leaf curl of Japanese plums. Fully 80 per cent of the trees in the infected orchard were diseased, almost every terminal shoot of the season's growth being affected. Close pruning and burning of diseased branches and spraying the trees with Bordeaux mixture are recommended as possible means for eradication. The cause of the disease is thought to be *Exoascus mirabilis.*

A serious attack of the powdery mildew of grape (*Uncinula spiralis*) is reported, and thorough spraying of the vines is advised, the first application to be given before flowering, the second immediately after the fall of the flowers, and others at intervals as required.

A melon disease is described, which is considered due to a species of Alternaria that is probably the same as that described by E. F. Smith.[1] The disease is "characterized by a wilting of the leaves, followed by the appearance of small yellowish spots and blotches; these increased rapidly in size, the surface of the diseased areas became marked with dark, concentric rings, the tissues became dry and brittle, and upon all the older spots there was a copious growth of black mold distinctly visible with a lens." Applications of Bordeaux mixture were apparently without effect in checking the disease.

A brief report is given of a severe attack of leaf spot of plums

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[1] Jour. Mycology, 7, p. 373 (E. S. R., 6, p. 557).

(*Cylindrosporium padi*) in an unsprayed orchard. The injury could have been prevented by the proper use of fungicides.

The hollyhock rust (*Puccinia malvacearum*) is described, and the use of a wash of potassium permanganate is recommended for its prevention.

Attention is briefly called to winterkilling of peach trees and frost injury to pears, both of which were attributed to unusual climatic conditions, against which there seems no practical means of protection.

Note on Plasmodiophora brassicæ, M. C. POTTER (*Nature, 55 (1896), No. 1411, p. 33*).—The occurrence of club root on *Capsella bursa-pastoris* in England is reported. Experiments of the author show that the fungus can maintain its vitality for at least 3 years in the soil.

Scabby potatoes (*Agl. Jour. Cape Colony, 9 (1896), No. 22, p. 559*).—Compiled notes are given on the use of corrosive sublimate and copper sulphate for the prevention of potato scab. The treatment with corrosive sublimate was the more successful.

Rotting of turnips and swedes, M. C. POTTER *Jour. [British] Bd. Agr., 3 (1896), No. 3, pp. 120–131, figs. 13*).—Notes are given on attacks of Botrytis on stored roots, and care is urged in securing thorough ventilation and drainage for the pits.

The fungus diseases of African cereals, P. HENNINGS (*Notizbl. kl. bot. Gard. und Mus. Berlin, 1896, No. 4, p. 117; abs. in Hedwigia, 35 (1895), No. 5, p. 108*).—Compiled notes are given of the diseases of sorghum, rice, and maize.

The rusts of grain, their history, nature, and means of combating, J. ERIKSSON and E. HENNINGS (*Die Getreideroste ihre Geschichte und Natur sowie Massregeln gegen dieselben. Stockholm: P. A. Norstedt und Söner, 1896, pp. 463, pls. 14, figs. 5*).

The rusts and mildews of cereal crops (*Gard. Chron., ser. 3, 20 (1896), No. 516, p. 591*).—An abstract is given of Eriksson and Hennings's *Die Getreideroste.*

A new smut, J. J. DAVIS (*Bot. Gaz., 22 (1896), No. 5, pp. 413, 414*).—*Burrillia globulifera* is described as a new species of smut found on culms of *Glyceria fluitans.*

Experiments for checking apple rot and codling moth in 1895, H. GARMAN (*Kentucky Sta. Rpt. 1895, pp. 113–129, pls. 4*).—A reprint of Bulletin 59 of the station (E. S. R., 8, p. 61).

A fungus disease of apple, G. H. POWELL (*Garden and Forest, 9 (1896), No. 457, pp. 474, 475*).—Notes are given of *Leptothyrium pomi*, which causes small black spots on apples.

Black rot and grape cuttings, A. CARRÉ (*Prog. Agr. et Vit., 26 (1896), No. 46, pp. 556–559*).

Bacteriosis of walnuts, N. B. PIERCE (*California Fruit Grower, 19 (1896), Nos. 13, p. 243; 16, p. 316*).

Carnation anthracnose (*Amer. Florist, 12 (1896), No. 444, p. 434*).—A brief note is given of an anthracnose attacking carnations, the variety Aurora being especially susceptible.

Investigations concerning injuries by smoke, R. HARTIG (*Ztschr. Forst. und Jagdw., 28 (1896), No. 11, pp. 680–687*).—A controversial article to which Dr. C. Ramann makes a reply.

Some tendencies and problems in the evolution of parasitic fungi, G. F. ATKINSON (*Trans. Massachusetts Hort. Soc., 1896, 1, pp. 98–118*).

Pathological notes from the Botanical Institute of the University of Liège, A. GRAVIS (*Bul. Soc. Roy. Bot. Belgique, 34 (1895), II, pp. 9–26*).—Miscellaneous notes are given on fungi attacking many cultivated plants.

Spray calendar, R. H. MILLER (*Maryland Sta. Bul. 39*).—A reprint of New York Cornell Station Bulletin 114 (E. S. R., 8, p. 149).

ENTOMOLOGY.

The honey bee: A manual of instruction in apiculture, F. BENTON (*U. S. Dept. Agr., Division of Entomology Bul. 1, n. ser., pp. 118, pls. 11, figs. 76*).—This treatise is designed to make the practical management of an apiary plain to those whose acquaintance with the subject is limited, and to give a system of management which may be followed on an extensive scale with the certainty of fair remuneration for the labor and capital invested. The author has deemed it advisable to treat the natural history of the bee but briefly and to give little attention to matters that are in dispute or such as are only of local application, the intention being to explain apiculture in a way adapted to all conditions. The methods suggested are those which the author has found practicable through an extended experience. Descriptions of different varieties of the common honey bee, *Apis mellifica*, are given, as well as of *A. indica*, *A. florea*, and *A. dorsata*, East Indian species of probable economic value if introduced into this country.

The colony is described and methods for its management are given, together with descriptions of hives and implements necessary. A chapter is given on bee pasturage, in which quite a number of plants visited by bees are figured and described. Lists are given of the principal honey plants, and an attempt is made to indicate which are the most important as pollen and honey producers. The manipulation of the brood and its natural or artificial increase is described at considerable length. In the chapter devoted to wintering bees brief explicit directions are given, the following of which will prevent any considerable loss. The diseases and enemies of bees are described and suggestions offered for preventing their attacks.

The pernicious or San José scale, J. B. SMITH (*New Jersey Stas. Bul. 116, pp. 15, figs. 3*).—The author reviews the history of the importation of the pernicious or San José scale (*Aspidiotus perniciosus*), and refers to the work which has already been done by the station in studying its life history and means for its prevention. During the past season the author made a trip to California to study the insect in that State, and in the present bulletin conclusions from his observations are given, the details being reserved for a later publication.

The author states that all deciduous trees in New Jersey are liable to attacks by this insect, and suggests various remedial measures for prevention. Most of these have been tested in California and found to be efficient. The chief dependence is placed on the lime, sulphur, and salt wash, for which 3 modified formulas are given. Other formulas are given for washes containing unslacked lime and sulphur (100 lbs. each) and blue vitriol (8 lbs.); and concentrated lye ($3\frac{1}{3}$ lbs.), water ($7\frac{1}{2}$ gals.), and fish oil (1 gal.). Both of these formulas are said to be very efficient.

Pure kerosene is said to be fatal to the San José scale, but is usually

considered to be extremely injurious to the trees as well. Some experiments recently conducted at the Ohio Experiment Station are briefly outlined, in which the experimenter sprayed apple and peach trees with pure kerosene without apparent injury. The author does not recommend it, especially on young trees, but in a badly infested orchard it might pay to risk a few trees as an experiment.

The codling moth and the apple maggot, C. M. WEED (*New Hampshire Sta. Bul. 35, pp. 29–35, figs. 3*).—Popular notes are given of the 2 most destructive insects affecting the fruit of the apple in New Hampshire, the codling moth and the apple maggot. The first-named insect has apparently not increased in destructiveness during the past 20 years, while the apple maggot is undoubtedly increasing from year to year.

For the prevention of the codling moth, spraying with Paris green is recommended, applying the insecticide when the apples are from the size of a pea to that of a hickory nut. Two, and in case of very wet weather, 3 applications are recommended.

For the apple maggot spraying does not prevent injury, since the eggs are deposited beneath the skin of the fruit, and the destruction of windfalls and general clean culture seems to be the best way of keeping this insect in check.

Proceedings of the seventh annual meeting of the Association of Economic Entomologists (*U. S. Dept. Agr., Division of Entomology Bul. 2, n. ser., pp. 100, fig. 1*).—This contains the papers and discussions before the meeting at Springfield, Massachusetts, August 27 and 28, 1895.

Entomological notes and problems, J. B. Smith (pp. 6–18).—Advocates careful coöperation among entomologists by assisting in the study of the same insects and comparing results, deprecates the publishing of incorrect popular articles by newspapers, and urges prompt and concerted action against insect pests as soon as their presence is known.

Notes on insecticides, C. L. Marlatt (pp. 19–26).—Experience with a mechanical mixture of kerosene and water against the euonymus scale indicated that it was not so effective as kerosene emulsion, and that the percentage of oil could not be regulated. Soaps and arsenite of copper were satisfactorily tested as insecticides, and notes are given on arsenate of lead and cyanid of potassium.

Some experiments with the knapsack kerosene attachment, H. E. Weed (pp. 26–28).—The author's experience with a mechanical mixture has been most satisfactory both in killing insects and not injuring the foliage.

A modification of the kerosene knapsack sprayer, C. M. Weed, and *spraying without a pump, J. M. Aldrich* (pp. 28–30).—Authors' abstracts of descriptions of contrivances for the mechanical mixture of kerosene and water, followed by discussions of the papers.

"Raupenleim" and "Dendrolene," J. B. Smith (pp. 31, 32).—An

author's abstract of a paper detailing experiments to ascertain the actual and comparative value of these insecticides. Both proved advantageous, but Dendrolene is rather preferred. The paper is followed by a discussion of these and other insecticides.

Herbivorous habits of certain Dermestidæ, F. H. Chittenden (pp. 36, 37).—An author's abstract, followed by a discussion of methods of treating various household pests.

Some shade-tree insects of Springfield and other New England cities, L. O. Howard (pp. 40–47).—The paper treats chiefly of the ravages of the elm leaf beetle and woolly maple leaf louse, and urges prompt municipal action on scientific lines as soon as their presence is noted. The use of fire engines for spraying is suggested.

The elm leaf beetle in Washington, C. L. Marlatt (pp. 47–50).—An account of successful treatment, particularly of the trees in the grounds of the Department of Agriculture, by means of several sprayings with arsenate of lead and Paris green, followed by an application of kerosene emulsion to the bases of the trees to kill the pupæ.

The elm leaf beetle in Albany, J. A. Lintner (pp. 50–56).—The ravages of this species in Albany in 1895 are detailed, the English elm suffering most. Spraying was found impracticable, and instead is recommended treating the pupæ at the bases of the trees with hot water or kerosene. In the discussion which followed, spraying with arsenate of lead was strongly advocated.

Notes on the gypsy moth in Massachusetts, C. H. Fernald (pp. 59–67).—A general history of the spread, ravages, and methods of treatment of this pest, with a brief account of the investigations of its life history. In the ensuing discussion the insecticides employed and the importance of constant vigilance were touched upon.

The striped cottonwood beetle, J. A. Lintner (pp. 69–74).—An account of *Melasoma scripta* attacking osier willows in the western part of New York, where both as larva and adult it has caused great damage by eating the leaves and bark. Spraying with the arsenites, supplemented by collecting the beetles by means of a "bug catcher," resembling a "hopperdozer" in form, has proved of most efficacy.

On the study of forest-tree insects, A. D. Hopkins (pp. 75–78).—This discusses the character and extent of damage to forests by insects, with some estimated figures, the loss in West Virginia for the last 10 years being set down as $25,000,000 annually, chiefly due to Scolytids. The need of further work among forest insects is urged.

The importation and repression of destructive insects, F. M. Webster (pp. 79–83).—Urges earnest coöperation in dealing with new pests, and preventing their spread by firm quarantines. In the discussion great caution was insisted upon in pronouncing a nursery free from dangerous insects.

Insects of the year in Ohio, F. M. Webster (pp. 84–91).—The Hessian fly, cutworms, chinch bug, and plum scale were the most injurious,

although other insects showed a tendency to become dangerous in the near future.

On the natural conditions which affect the distribution and abundance of Coccidæ. T. D. A. Cockerell (pp. 91–95).—A general paper, treating of the adoption of different food plants, individual variations within species, and other factors.

How shall we improve our collections? C. P. Gillette (pp. 95–97).—An interchange of specimens between economic entomologists is suggested, and the greater use of sweep nets for rapid collecting is recommended.

Carbon bisulphid for crayfish, H. E. Weed (pp. 98, 99).—Pouring an ounce of the chemical into a crayfish hole and at once closing the opening almost invariably killed the crustacean.

Analyses of three common insecticides, F. W. MORSE (*New Hampshire Sta. Bul. 36, pp. 37–40*).—Analyses are reported of 5 different brands of Paris green, 1 of London purple, and 1 of white hellebore.

The analyses of Paris green showed a variation in the percentage of arsenic trioxid of from 55.35 to 56.69 per cent. These analyses showed no adulteration, the amount of arsenic trioxid present being nearly that required by theoretical composition.

The analysis of the London purple showed 37.56 per cent of arsenic trioxid, which is slightly less than the average amount as reported by other stations.

The analysis of white hellebore showed 33.13 per cent of ash, with an abundance of iron and aluminum oxids and insoluble silicious matter, indicating considerable adulteration with clay. Four other samples of hellebore were analyzed later, and one was found to be adulterated to a considerable degree. Unless the roots from which this insecticide is made are thoroughly washed before pulverizing, there will undoubtedly be a considerable amount of earthy matter in the powdered article.

Construction of the comb of the hive bee, C. PHILLIPS (*Trans. New Zealand Inst., 28 (1895), pp. 479–490*).

Foul brood, or bee pest (*Jour. [British] Bd. Agr., 3 (1896), No. 3, pp. 132–134*).—Notes are given on *Bacillus alvei* and suggestions for preventing its attacks

The tsetse fly disease (*Agl. Jour. Cape Colony, 9 (1896), No. 14, pp. 358–360*).

New Mallophaga, II, V. L. KELLOGG (*Leland Stanford Jr. University Publications, Contr. from Hopkins Seaside Laboratory, 1896, No. 7, pp. 429–548, pls. 14*).—The author figures and describes 33 new species of Mallophaga parasitic on land birds. In addition to these new species, 16 species described by European authors, but now known as parasitic to American birds are given. In the present paper a detailed account is given of the mouth parts of the genera of Mallophaga and comparisons made with those of various groups more or less intimately connected with them.

Contributions toward a monograph of the Aleurodidæ, W. M. MASKELL (*Trans. New Zealand Inst., 28 (1895), pp. 411–449, pls. 12*).

The army worm in Ohio, J. S. HINE (*Proc. Columbus Hort. Soc., 11 (1896), No. 2–3, pp. 59–61*).—Notes on an outbreak of Leucania in northwestern Ohio in 1896.

The bagworm (*Meehan's Monthly, 6 (1896), No. 12, p. 233, figs. 2*).—Notes are given on *Thyridopteryx ephemeræformis*. Hand picking and the use of arsenites are recommended for its destruction.

The small cabbage moth, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 444–449, pls. 2*).—Notes are given on *Plutella cruciferarum* and its wasp parasite.

Recent investigations concerning Cnethocampa pinivora, ALTUM (*Ztschr. Forst. und Jagdw., 28 (1896), No. 11, pp. 649–652*).

The Crambidæ of North America, C. H. FERNALD (*Appen. to Massachusetts Agl. College Rpt. 1895, pp. 77–165, pls. 9, figs. 3*).—The author has given an extended account of the history and life history, together with notes on the distribution and natural enemies of this family of insects. A revision is also given of the genera and species known in North America. Eugrotea and Pseudoschœnobius are described as new genera. Numerous new species and combinations are described and the synonomy very fully given. The plates seem to be prepared with great pains and are well reproduced.

Cutworms in Kentucky, H. GARMAN (*Kentucky Sta. Rpt. 1895, pp. 89–109, pl. 1, fig. 1*).—A reprint of Bulletin 58 of the station (E. S. R., 8, p. 66).

Fig beetle, C. P. LOUNSBURY (*Agl. Jour. Cape Colony, 9 (1896), No. 14, pp. 361, 362*).—Notes are given of the destructive attacks of *Phryneta spinator* on figs in South Africa.

The gypsy moth in Massachusetts (*Canadian Ent., 28 (1896), No. 11, pp. 279–283*).—A discussion is given of the work of the commission in destroying this pest.

The so-called Mediterranean flour moth, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 449, 450*).—Brief notes are given of *Ephestia kuehniella*.

On the appearance of Hylesinus minor and H. piniperda (*Forstw. Centbl., 18 (1896), No. 11, pp. 557–562*).

The pear slug, G. H. POWELL (*Garden and Forest, 9 (1896), No. 459, p. 498*).—Notes are given of injuries to pear trees in portions of Delaware by *Eriocampa cerasi*. Air-slacked lime, pyrethrum, or hellebore will destroy it.

The San José scale (*Amer. Monthly Micr. Jour., 18 (1896), No. 10, pp. 323–330*).

The San José scale, W. C. STURGIS and W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 194–202, figs. 5*).—The subject-matter of this article has mostly been given in Bulletin 121 of the station (E. S. R., 7, p. 314).

Five new species of scale insects, W. G. JOHNSON (*Illinois State Lab. Nat. Hist. Bul. 4, 1896*).—Descriptions and notes are given of the following new species: *Aspidiotus forbesi, A. comstocki, A. æsculi, A. ulmi*, and *Chionaspis americana*.

Some scale insects, L. O. HOWARD (*Trans. Massachusetts Hort. Soc., 1896, I, pp. 84–96, figs. 8*).

A check list of Coccidæ, T. D. A. COCKERELL (*Illinois State Lab. Nat. Hist. Bul. 4, 1896, pp. 318–339*).—The author gives a list of authorities and a check list of genera and species of the Coccidæ and indicates briefly their distribution. The number of species given is about 800.

Coccid notes, with descriptions of new species, W. M. MASKELL (*Trans. New Zealand Inst., 38 (1895), pp. 380–411, pls. 8*).

Termitidæ observed in southwestern Texas in 1895, E. A. SCHWARZ (*Proc. Ent. Soc. Washington, 4 (1896), No. 1, pp. 38–42*).

Importance of termites in the movement and natural culture of tropical soils, O. LENZ (*Mitt. k. k. Geog. Ges. Wien, 37, No. 11–12, pp. 711–725*).

A pod-inhabiting beetle found at the Columbian Exposition, F. H. CHITTENDEN and M. L. LINELL (*Proc. Ent. Soc. Washington, 4 (1896), No. 1, pp. 42, 43*).—Notes are given of *Baryssinus leguminicola* n. sp., a longicorn found breeding in seed from Paraguay.

Lawn and grass infesting insects, II, J. B. SMITH (*Garden and Forest, 9 (1896), No. 457, pp. 472, 473, figs. 2*).—Notes are given of May beetles and other insects, with suggestions of remedial measures.

Insects injurious to fruits and vegetables and remedies for destroying them, J. T. STINSON (*Arkansas Sta. Rpt. 1895, pp. 55–97, figs. 18*).—A reprint of Bulletin 33 of the station (E. S. R., 7, p. 41).

Notes on injurious insects, W. C. STURGIS (*Connecticut State Sta. Rpt. 1895, pp. 191–194*).—Brief notes are given descriptive of the injury done by certain insects and means are suggested for the destruction of the pests. Those enumerated are: Wheat midge (*Cecidomyia tritici*), bark beetle (*Scolytus rugulosus*), San José scale (*Aspidiotus perniciosus*), scale on tulip trees (*Lecanium tiliæ*), scale on oak (*Asterodiaspis quercicola*), and scale on honeysuckle (*Lecanium* sp.).

Further notes on injurious insects, W. E. BRITTON (*Connecticut State Sta. Rpt. 1895, pp. 203–213, pls. 2, figs. 3*).—Illustrated life history and remedial notes are given of the following insects: Plant-house aleyrodes (*Aleyrodes vaporariorum ?*), leaf miner of the cauliflower (*Drosophila flaveola*), cabbage plusia (*Plusia brassicæ*) on tomatoes in greenhouses, raspberry root gallfly (*Rhodites radicum*), cabbage root maggot (*Phorbia brassicæ*), and elm leaf beetle (*Galeruca xanthomelæna*). The notes on the elm leaf beetle have already appeared in Bulletin 121 of the station (E. S. R., 7, p. 314). A detailed description is given of a steampower spray pump that is applicable for spraying very tall trees.

Report of the entomologist, C. H. FERNALD (*Massachusetts Hatch Sta. Rpt. 1895, pp. 209–212*).—A brief report is given of the work that has engaged the attention of the entomologist during the past year. Gypsy moth experiments have taken up most of the author's time. The San José scale is reported from several sections throughout the State, and the elm leaf beetle seems to have spread quite extensively. The studies begun on cranberry insects have been continued and will be the subject of a future bulletin.

Report of the division of entomology and botany, H. GARMAN (*Kentucky Sta. Rpt. 1895, pp. XXXII–LVII, pls. 4*).—A brief résumé is given of the botanical work, much of which has been published in bulletin form, together with entomological notes for 1895, in which brief descriptions and suggestions for the repression of the following insects are given: Cutworms, the scurfy bark louse (*Chionaspis furfurus*), San José scale (*Aspidiotus perniciosus*), strawberry snout beetle (*Epicærus imbricatus*), northern June bug (*Lachnosterna* spp.), southern June bug (*Allorhina nitida*), imported currant worm (*Nematus ventricosus*), black peach aphis (*Aphis persicæ-niger*), grape phylloxera, fruit bark beetle (*Scolytus rugulosus*), zebra caterpillar of cabbage (*Mamestra picta*), corn fly (*Chætopsis ænea*), harlequin cabbage bug (*Murgantia histrionica*), regal walnut moth (*Citheronia regalis*), throat bot fly of the horse (*Gastrophilus nasalis*), common horsefly (*Stomoxys calcitrans*), black carpet bug (*Attagenus piceus*), and chinch bug (*Blissus leucopterus*).

Injurious insects and fungi (*Jour. [British] Bd. Agr., 3 (1896), No. 2, pp. 153–166, figs. 4*).—Notes are given of the cherry moth (*Argyresthia nitidella*), the onion fly (*Phorbia cepetorum*), *Carpocapsa pomonella* in walnuts, the hop bug (*Calocoris fulvomaculatus*), surface caterpillars (*Agrotis* spp.), and tomato rot (*Cladosporium lycopersici*), together with suggestions for combating them.

Dendrolene as an insecticide, J. TROOP (*Garden and Forest, 9 (1896), No. 458, p. 488*).—Notes are given on the use of this substance on peach and apple trees, and through its action the young trees were visibly affected, some being killed.

Concerning the causes of plant injuries through the use of insecticides, CARL MOHR (*Ztschr. Pflanzenkrank., 6 (1896), No. 4, pp. 208, 209*).—The injurious effect of certain insecticides is mentioned and an aqueous solution of calcium sulphite in glycerin is recommended as harmless to plants while efficient against aphides.

Analyses of insecticides, C. A. GOESSMANN and H. D. HASKINS (*Massachusetts Hatch Sta. Rpt. 1895, p. 353*).—Analyses of 21 samples of insecticides, including Paris green, hellebore, tobacco liquor, and several patented articles are tabulated.

Some facts about insects, A. L. QUAINTANCE (*Florida Farmer and Fruit Grower, 8 (1896), No. 49, p. 780, fig. 1*).—Popular notes are given on the life history and classification of insects.

On the larvæ of the higher Bombyces, H. C. DYAR (*Proc. Boston Soc. Nat. Hist., 27 (1896), pp. 127–147*).

Jumping cocoons (*Nature, 55 (1896), No. 1412, p. 65*).—A brief note is given of the ability to jump shown by some African cocoons. The insect is thought to be an anomalous lepidopter, near Adela.

Resemblance of an insect larva to a lichen fruit, G. E. STONE (*Bul. Torrey Bot. Club, 23 (1896), No. 11, pp. 444, 445*).—Brief notes are given of mimicry in the larvæ of *Gossyparia ulmi*.

Effect of cold on insect life, K. SAJO (*Illus. Wochenschr. Ent., 1896, Oct., pp. 457–469*).

The displacement of species in New Zealand, T. KIRK (*Trans. New Zealand Inst., 38 (1895), pp. 1–27*).—Brief notes are given on the displacement of certain species of insects by the introduction of others.

On the so-called animal plants, P. HENNINGS (*Naturw. Wochenschr., 1896, p. 317*).—Some of the species of Cordyceps are described and figured.

FOODS—ANIMAL PRODUCTION.

Studies of dietaries, W. O. ATWATER and C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1895, pp. 129–174*).—The work here reported is a continuation of that given in the Annual Reports of the station for 1892, 1893, and 1894 (E. S. R. 5, p. 394; 6, p. 443; 7, p. 596). The results of 11 dietary studies hitherto unpublished are reported in full. A summary follows:

Results of dietary studies—Food eaten per person daily.

	Cost.	Protein.	Fat.	Carbo-hydrates.	Fuel value.
Infant (9 months old):	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
First study	08	53.4	66.3	48.7	1,035
Second study	08	52.9	57.1	81.0	1,080
Chemist's family	24	102.0	98.0	378.0	2,880
Do	26	91.0	150.0	399.0	3,405
Do	24	122.0	147.0	410.0	3,550
Farmer's family in Vermont	....	69.0	92.0	444.0	2,960
Farmer's family in Connecticut	....	108.0	76.0	635.0	3,755
Do	....	109.0	91.0	608.0	3,785
Do	....	100.0	121.0	501.0	3,590
Do	....	79.0	117.0	354.0	2,865
Do	....	131.0	161.0	433.0	3,810
College students in Connecticut	....	104.0	156.0	494.0	3,900

Dietary studies at the University of Tennessee in 1895, C. E. WAIT, comments by W. O. ATWATER and C. D. WOODS (*U. S. Dept. Agr., Office of Experiment Stations Bul. 29, pp. 45*).—Three dietary studies, 2 in winter and 1 in spring, were made of a students' club at the University of Tennessee, and 1 of a mechanic's family. The methods followed were those mentioned in Bulletin 21 of this Office (E. S. R., 7, p. 148). A number of Tennessee foods were analyzed. The composition of other foods was computed from standard tables. Tables are given which show the amount and kind of food purchased, wasted, and eaten, and its cost, composition, and fuel value. The results of these studies are briefly summed up in the following table:

Results of dietary studies—Food eaten per man per day.

	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
College Club:	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
First study	15¾	93	132	457	3,480
Second study	15½	93	122	472	3,450
Third study	17½	88	128	510	3,635
Mechanic's family	14½	110	210	412	4,090

In the comments on these dietary studies the results are compared with results of similar studies made in other localities in the United States and with the accepted dietary standards. The Tennessee beef is also compared with that raised in other regions.

The following conclusions were reached:

"So far as the analyses which have been made are concerned, beef grown near Knoxville, in Tennessee, is much leaner than that grown in the North and Northwest. That this is so is not against but rather in favor of the Tennessee-raised beef. . . .

"In general these dietary studies at Knoxville agree with those made elsewhere in implying that the food consumed by the people of the United States contains relatively too little of the flesh formers and too much of the fuel ingredients. . . .

"The few accurate studies thus far made imply that this one-sidedness is greater in the South than in the North, and accord with the general impression that the common diet in the former region contains an excess of the fatter kinds of meats, such as pork, and of the starchy and sugary vegetable foods, such as corn meal and molasses. What is needed is to use foods better adapted to the needs of the body, in other words, foods which contain more protein. Such are lean meats, as beef and veal and chicken; fish, like salt cod and mackerel, and fresh fish, where they are obtainable; milk, which is of itself an economical and well-balanced food; skim milk, which has all the protein and half the fuel value of whole milk and is in most localities the most economical source of animal protein; oatmeal; beans, peas, and other legumes, especially cowpeas."

The digestibility of tripe by man, P. SOLOMIN (*Arch. Hyg.*, *27 (1896), No. 2, pp. 176–188*).—The experiment was divided into two 3-day periods. In the first period the diet consisted of tripe, bread, butter, and a little flour (used in cooking the tripe). In the second an equivalent amount of meat was substituted for tripe. Beer was used as a beverage. Food, urine, and feces were analyzed. The results are given in detail in tabular form. The total nutrients consumed and those excreted in the feces and the nitrogen in the urine in each period are shown in the following table:

Digestion experiment with tripe.

	In food.				In feces.				In urine.
	Dry matter.	Nitrogen.	Fat.	Ash.	Dry matter.	Nitrogen.	Fat.	Ash.	Nitrogen.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Tripe period	1,665.41	71.12	377.2	60.77	108.4	7.70	17.4	11.17	55.1
Meat period	1,586.22	85.47	230.29	75.43	99.75	8.19	9.29	8.73	76.8

The coëfficients of digestibility for the tripe period were, dry matter 93.49, nitrogen 89.16, fat 95.36, and ash 81.61 per cent; and for the meat period, dry matter 93.71, nitrogen 90.41, fat 95.96, and ash 88.41 per cent. The author believes that in general there is no marked difference in the digestibility of tripe and meat.

The author mentions the fact that little of the nitrogen in tripe is in the form of albumen; most of it is in the form of connective tissue. More chlorin and less phosphoric acid were excreted in the urine during the tripe period than when meat was consumed. In the author's

opinion this is due to the fact that tripe is richer in compounds containing chlorin (mucous membrane, etc.) and poorer in phosphates than meat.

Food preservatives and butter increasers, G. W. CAVANAUGH (*New York Cornell Sta. Bul. 118, pp. 399–404*).—Two food preservatives, "Preservitas" and "Callerine," and two butter increasers, "Chase's Butter Increaser" and "Gilt Edge Butter Compound" were examined. The "Preservitas" was found to consist of borax and a little salicylic acid and sugar, the "Callerine" of a 7 per cent solution of formic aldehyde. The author points out that this substance is sold for a very high price compared with its actual cost, and he believes that the use of formic aldehyde in preserving milk may possibly so alter its composition as to render it less digestible than normal milk.

"Chase's Butter Increaser" was found to consist of a 25 per cent solution of acetic acid and a small amount of salicylic acid. The "Gilt Edge Butter Compound" consisted of about equal parts of alum and soda with a little pink coloring matter. These articles increase the yield of butter by precipitating the casein in the milk, and a considerable portion of it will be included in the butter. The author condemns the use of "butter increasers" as fraudulent.

Salt hays and meadow or swale hay, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 240–246*).—Experiments were made with 2 sheep to determine the digestibility of black grass, high-grown salt hay, branch grass, low meadow fox grass, and swale hay. The black grass consisted almost exclusively of *Juncus bulbosus*.

"The low meadow fox grass appeared to consist practically of what is also called rush salt grass (*Spartina juncea*), and both the high-grown salt hay and the branch grass were composed of this as a basis, mixed with more or less coarse grass, probably *Spartina stricta* var. *glabra*. The branch grass contained rather more of the coarse material than did the high-grown salt hay. . . .

"Meadow or swale hay grows in the fresh-water meadows, and is composed of fresh-water grasses, sedges, brakes, and wild flowers."

The composition of these hays, with timothy hay for comparison, is given in the following table:

Analyses of hay.

	Water.[1]	Crude protein.	Crude fat.	Nitrogen-free extract.	Crude cellulose.	Crude ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Black grass	15	8.08	2.23	42.00	22.78	9.91
High-grown salt hay	15	6.36	2.13	47.14	22.45	6.92
Branch grass	15	7.03	1.88	44.84	22.50	8.75
Low meadow fox grass	15	6.06	2.18	49.22	22.58	4.96
Swale hay	15	6.77	1.59	44.97	26.40	5.27
Timothy hay	15	6.30	2.40	43.60	28.40	4.30

[1] Assumed.

The coëfficients of digestibility found with sheep are shown in the following table:

Coëfficients of digestibility of hay.

	Total dry substance.	Crude protein.	Crude fat.	Nitrogen-free extract.	Crude cellulose.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Black grass	59.5	63.0	41.5	57	60.5
High-grown salt hay	53.0	63.0	47.0	53	50.0
Branch grass	56.0	62.5	32.0	54	52.0
Fox grass	53.0	57.0	24.0	52	51.0
Swale hay	39.0	34.0	44.0	46	33.0
Timothy hay	58.0	48.0	61.0	63	53.0

A table is given showing the digestible nutrients in 2,000 lbs. of the several hays, assuming that each contained 15 per cent of water.

From these tests the author draws the following general conclusions:

"(1) Black grass, high-grown salt hay, branch grass, and low meadow fox grass are all valuable fodder articles. In the present experiment black grass contained more protein and showed a higher average digestibility, and is therefore superior to the other 3 hays. There is no wide difference, however. Timothy hay shows more total digestible organic matter, but is noticeably inferior to 3 of the salt hays in digestible protein. Black grass might be classed as but little inferior to average timothy hay. High-grown salt hay, branch grass, and fox grass resemble each other very closely in feeding value.

"(2) Salt hays at average market prices are decidedly cheaper to feed than English hay.

"(3) Meadow or swale hay is a very inferior article. It contained 150 to 200 lbs. less digestible matter than did the salt hays, and but 39 per cent of digestible dry matter.

"(4) Hays containing much less than 50 per cent of digestible dry matter should be regarded as of very inferior quality."

General directions are given for feeding salt hays and meadow hays, and some advice on purchasing grains on the basis of their content of digestible nutrients.

Digestion experiments with sheep, C. S. PHELPS and C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1895, pp. 187–214*).—This is a continuation of work given in the Annual Report of the station for 1894 (E. S. R., 7, p. 597). Seventeen new experiments are reported and one is reprinted from the Annual Report for 1894 on account of an error. Each experiment lasted 12 days. Feces were collected during the last 5 days. Six experiments were made with 4 sheep, 6 with 2 sheep, 1 with 3 sheep, and 1 with 6 sheep. The rations fed consisted of soja beans and timothy hay, crimson clover hay (field cured and barn cured), barley fodder, oat and pea fodder, oat fodder, Hungarian fodder, soja bean fodder, clover rowen, sweet clover fodder, cowpea fodder, rowen (mostly timothy), and Canadian pea fodder. The results are briefly given in the following table.

Coëfficients of digestibility.

Kind of food.	Number of tests.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.	Organic matter.	Fuel value.[1]
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Soja bean meal and timothy hay	4	77.2	74.2	66.3	60.6	48.4	69.0	64.3
Do	4	78.2	73.1	66.0	62.0	45.7	69.3	64.6
Soja bean meal[2]	8	85.8	84.9	73.4	....	21.3	78.0	72.5
Scarlet clover hay (field cured	4	68.3	49.2	60.0	43.8	47.0	54.8	50.0
Scarlet clover hay (barn cured)	3	69.3	34.9	61.8	46.2	47.5	57.2	51.2
Scarlet clover hay (average field and barn cured)	7	68.7	43.0	60.8	44.8	47.2	55.8	50.5
Barley fodder	4	71.7	59.9	71.2	60.7	54.4	67.5	62.4
Oat and pea fodder	2	81.5	73.6	66.4	57.5	31.2	67.9	63.2
Oat fodder	2	75.3	69.8	63.1	60.2	44.8	64.5	61.1
Hungarian fodder	4	65.3	72.3	68.9	72.8	58.5	70.1	67.0
Soja bean fodder	4	74.0	54.2	72.7	45.5	14.0	64.1	59.7
Clover rowen	2	61.9	60.8	65.3	52.5	43.4	60.8	56.5
Sweet corn fodder	6	61.8	79.3	77.2	60.0	50.4	72.1	68.5
Cowpea fodder	2	74.0	59.4	84.2	57.5	23.9	76.0	71.1
Rowen, mostly timothy	2	71.7	52.0	67.8	63.8	45.2	66.4	60.3
Canada pea fodder	2	82.0	52.4	71.0	62.4	42.3	71.3	64.7

[1] Percentage of total fuel value which is available for the use of the body, *i. e.*, the fuel value of the digested portion minus the fuel value of the urea. (See E. S. R., 7, p. 597).
[2] Computed from experiments with soja bean meal and timothy hay.

Wheat meal vs. rye meal for pigs, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 237–239*).—An experiment to compare wheat meal and rye meal fed with skim milk was made with 2 lots of 3 pigs each (2 barrows and 1 sow). It lasted 106 days, and was divided into 3 periods of 58, 13, and 35 days, respectively. In the first period the plan was to feed lot 1 3 oz. of wheat meal and lot 2 3 oz. of rye meal to each quart of milk, the nutritive ratio of the ration being 1:3.6. Owing to an insufficient supply of milk, it was necessary to feed some Peoria gluten feed to keep up the nutritive ratio. In the second period each lot was fed 4 qts. of milk daily, lot 1 receiving in addition wheat meal and lot 2 rye meal to satisfy the appetite. In the third period 4 qts. of milk was fed, and lot 1 received equal parts of wheat meal and corn meal, and lot 2 equal parts of rye meal and corn meal in quantities sufficient to satisfy the appetite. Sufficient water was added to the milk and meal to furnish the necessary amount of liquid. The pigs were fed 3 times daily.

The financial statements are based on the following prices: Skim milk 2 cts. per gallon, and wheat and rye $24, Peoria gluten feed $21, and corn meal $23 per ton. The pigs were sold for 4.8 cts. per pound, live weight. The results are expressed in tabular form.

"Both lots of pigs made very fair gains, and the results as a whole compare favorably with other experiments when skim milk was fed with other grains. The average daily gain was nearly 1¼ lbs., and the dry matter required to make 1 lb. of live weight averaged 2.65 lbs. The skim milk returned 0.6 ct. per quart, and the live weight cost 4.37 cts. per pound, allowing skim milk to be worth 0.5 ct. per quart, and the grains as noted. The wheat meal seemed to give rather better results, especially in the last period. During this latter period the pigs fed on the rye meal ration were off feed a good deal of the time, and gained less in weight."

Experiments in fattening sheep, C. E. LYMAN (*Connecticut Storrs Sta. Rpt. 1895, pp. 93–100*).—One hundred and fifty lambs were selected

from a carload purchased in Buffalo and were placed in a large sunny pen. The test covered 3 months, from December, 1894, to February, 1895. During the first month the lambs were fed all they would eat clean of a mixture of corn silage and mixed grains in the proportion of 1:1. The grain ration consisted of equal parts by weight of corn, culled peas, wheat bran, and whole wheat. The silage and grains were thoroughly mixed. The lambs were fed night and morning. In addition they were given at noon all the hay they would eat up clean.

The hay and silage were weighed on several days each month, and the average amount of each consumed computed from these data. During the second month the proportion of silage to grain was 70:100. During the third month the ration was the same as during the second, except that wheat was omitted from the mixed grains. The amount and composition of each of the feeding stuffs used during the 3 months are shown in tabular form.

The average gain in live weight per sheep for each month and the amounts of nutrients required to produce a gain of 1 lb. are shown in the following table:

Results of experiments in fattening sheep.

	Average weight.			Required to produce a gain of 1 lb. live weight.						
				Total nutrients.					Fuel value.	
	At start.	At close.	Gain.	Organic matter.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Calculated.	Determined.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Calories.*	*Calories.*
Period 1	71.4	75.6	4.2	13.25	1.93	.51	8.81	2.00	25,850	28,040
Period 2	71.0	81.4	10.4	6.96	1.07	.27	4.72	.90	13,580	14,160
Period 3	81.4	89.7	8.3	8.93	1.43	.34	6.01	1.15	17,410	18,870
Average	74.6	82.2	7.6	9.71	1.48	.37	6.51	1.35	18,950	20,360

During the first month the gains were small. In the author's opinion this was due to the fact that the silage was partly made from immature corn. This "soured the whole lot and made it a very inferior feed for lambs. By increasing the relative proportion of grain to the silage, the difficulty was overcome. The lambs immediately took on a thrifty appearance, ate nearly half as much again of grain, besides taking 400 lbs. more of silage during the second month than they did the first."

The article contains notes on methods practiced in handling sheep in Connecticut, the number of sheep in each pen, feeding, and marketing.

Poultry experiments, W. P. BROOKS (*Massachusetts Hatch Sta. Rpt. 1895, pp. 206–208*).—Two experiments, each consisting of 2 trials, were made with light Brahma and barred Plymouth Rock hens. In the first experiment the value for egg production of animal and vegetable food as the chief source of protein and fat was compared. Two trials were made with 2 lots of hens. "Both lots had pure water, artificial grit, and ground oyster shells always before them, and all other conditions were made as nearly as possible alike." The 2 lots were kept in houses

exactly alike in construction, each with nesting and laying room 10 by 12 ft., and scratching shed 8 by 10 ft. in size. In the first trial, lasting from December 9, 1894, to February 12, 1895, one lot of hens was fed soja-bean meal as a source of protein and fat, with cut alfalfa, oats, and middlings in addition; and the other lot was fed meat meal, with boiled potatoes, ground clover, wheat, wheat middlings, and cut bone in addition. The nutritive ratio was kept substantially the same for each lot.

In the second trial, lasting from January 1 to October 1, 1895, one lot was fed linseed meal and cotton-seed meal as a source of protein and fat, with wheat, oats, bran, and middlings in addition; and the other lot was fed meat meal with wheat, oats, wheat meal, bran, and linseed meal in addition. The nutritive ratio was kept substantially the same for each lot.

The results are briefly summarized in the following table:

Vegetable vs. animal foods for hens.

Food.	Duration of experiment.	Daily cost per fowl.	Number of eggs.	Water-free food eaten per egg.	Cost per egg.
	Days.	*Cents.*		*Pounds.*	*Cents.*
Vegetable food, first trial	64	0.21	11	23.830	0.3410
Vegetable food, second trial	153	.27	400	.917	.0150
Animal food, first trial	64	.24	79	3.554	.0550
Animal food, second trial	153	.33	622	.773	.0115

"In the above estimate of cost no charge is made for labor and no allowance for the droppings."

The young pullets used in the first trial were molting during the second trial, which in the author's opinion accounts for the small egg production.

"The results are decisive against the vegetable food and in favor of the animal in so far as effect upon egg production is concerned. The fowls receiving animal food were, moreover, in much better condition at the close of these experiments than the others."

The second experiment was made under the same general conditions as the first, and included 2 trials. The value for egg production of dried "animal" or "flesh" meals was compared with cut fresh bone. Some other feeds were given in addition, but the nutritive ratio was kept substantially the same. The results are summarized in the following table:

Flesh meal vs. cut fresh bone for hens.

Food.	Duration of experiment.	Daily cost per fowl.	Number of eggs.	Water-free food eaten per egg.	Cost per egg.
	Days.	*Cents.*		*Pounds.*	*Cents.*
Dried meat meal, first trial	64	0.266	185	1.185	1.70
Dried meat meal, second trial	153	.280	417	1.051	1.52
Cut fresh bone, first trial	64	.248	163	1.154	1.70
Cut fresh bone, second trial	153	.300	444	.978	1.43

"These results are rather indecisive, as in one experiment the meat meal and in the other the cut fresh bone gave the better results, as measured by egg production. The condition of the fowls receiving the meat meal has, however, been uniformly better than in the other lots."

The author remarks that it is difficult to feed cut bone so that it is evenly distributed.

"Some hens almost invariably secure more than their share, and this is equally true, whether the cut bone be scattered or mixed in a mash. The result is frequent diarrheas. The meat meal, on the other hand, can be evenly mixed in a mash, so that all fowls share alike, as it can not be picked out. Our results indicate that it is a safer feed than the bone; it is also a much cheaper feed; and, if it will give practically as many eggs, it is to be preferred. This experiment will be repeated."

Chemical composition of American food materials, W. O. ATWATER and C. D. WOODS (*U. S. Dept. Agr., Office of Experiment Stations Bul. 28, pp. 47, figs. 4*).—This bulletin includes a brief history of food analysis, explanations of terms used in discussing composition of food materials, and diagrams showing the methods of cutting beef, veal, pork, and mutton. The maximum, minimum, and average percentage composition and fuel value of a large number of American food materials are given, including different kinds and cuts of meat, fowl, fish, shellfish, dairy products, canned goods, vegetables, fruits, nuts, flour, meal, sugar, starches, bread, crackers, cake, and other prepared foods.

Poultry foods (*Connecticut State Sta. Rpt. 1895, pp. 226, 227*).—Analyses are given of 8 poultry foods which were sent to the station for examination. "All the preparations appear to consist chiefly of meat and bone having about the composition of 'bone tankage,' which is used as a fertilizer."

Results of analyses of fodders and feeding stuffs, C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1895, pp. 175–186*).—Analyses are reported of the following feeding stuffs: Green fodders—barley, Hungarian grass, oats, oats and peas, Canada field peas, cowpea vines, flat pea, soja bean vines, timothy rowen, clover rowen, corn fodder, sweet corn fodder, and corn silage; cured hay and fodders—corn stover, corn fodder and stover, scarlet clover hay, clover hay, hay of mixed grasses, Hungarian hay, timothy rowen, rowen hay, oat hay, and swamp hay; seeds—yellow and white flint corn, soja beans, and wheat; and milling and by-products—corn meal, corn-and-cob meal, cotton-seed meal, Buffalo gluten meal, Imperial feed, malt sprouts, old-process linseed meal, soja-bean meal, culled peas, refuse from manufacture of split peas, wheat bran, and wheat middlings.

Analyses of feeding stuffs (*Connecticut State Sta. Rpt. 1895, pp. 227–231*).—Analyses are given of a number of feeding stuffs which were sent to the station for examination, including maize kernel, gluten meal, gluten feeds, wheat bran, rice flour, barley feed, rye bran, "Cattle Feed," and "Hall's Dairy Ration."

"The intelligent dairyman can have but little use for ready-mixed rations of any sort. The grain and mill feed which he uses will be adjusted by him both in kind and in amount to balance the coarse fodder which he has on hand, and with greater economy and skill than by others whose business is selling feed and not dairying.

"The dairyman's opportunities for informing himself regarding the compounding of rations are ample. His chances of detecting adulterations, or the mixtures of mill wastes of inferior value are much better when he buys cotton seed, gluten, and bran separately, each of which has a tolerably definite and constant composition, than when he buys a mixture of a number of feeds with no such definite understanding as to its composition."

Compilation of analyses of fodder articles and dairy products, 1868–'96, C. S. CROCKER (*Massachusetts Hatch Sta. Rpt. 1895, pp. 248–264*).—This is a tabulated summary of analyses made at Amherst, Massachusetts, since 1868.

Fodder analyses, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp.

219–222).—During the year 49 samples of grains, by-products, and coarse feeds have been analyzed. The ingredients of feeding stuffs are defined, and descriptions and analyses of gluten feeds, oat feeds, gluten meals, brans, and rice meal are given.

Tables of the digestibility of American feeding stuffs, J. B. LINDSEY (*Massachusetts Hatch Sta. Rpt. 1895, pp. 265–276*).—Reprinted from the Annual Report of the State Station for 1894 (E. S. R., 7, p. 336), with corrections for the work of 1895.

Food investigations, W. O. ATWATER and C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1895, pp. 114–128*).—This is practically a reprint of Bulletin 15 of the station (E. S. R., 7, p. 803).

The advantage of raw goats' milk as food for children, SCHWARTZ (*Abs. in Milch Ztg., 25* (*1896*), *No. 44, p. 699*).—Some of the advantages mentioned are that goats are less subject to tuberculosis, that the milk keeps longer, that poor people will not pasteurize the milk for their children, and that goats are within the reach of poor people.

Goats' milk in the artificial feeding of children, OX (*Ind. Lait., 21* (*1896*), *No. 39, pp. 305, 306; abs. in Milch Ztg., 25* (*1896*), *No. 45, p. 716*).

Contributions to the study of pulque, F. ALTAMIRANDO (*Ann. Inst. Med. Nacional* (*Mexico*), *2* (*1896*), *No. 2, pp. 32–61*).—The article quotes an analysis by D. L. Rio de la Loza of this Mexican beverage.

The Imperial Health Department of Germany and the margarin question (*Milch Ztg., 25* (*1896*), *No. 24, pp. 377–379*).—A criticism of the position taken by the German health department on the healthfulness and other qualities of oleomargarin.

The use of leaves as food for animals, A. C. GIRARD (*Ann. Agron., 22* (*1896*), *No. 8, pp. 375–392*).—An extended discussion of the subject.

On the rancidity of olive oils in Tunis, R. MOULINE (*Bul. Agr. et Commerce, 1* (*1896*), *No. 1, pp. 24–28*).—Several analyses are given. The prevention of rancidity is discussed.

Fattening mature steers on cotton seed and cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 3–11*).—Appears to be a more extended account of an experiment briefly reported in Bulletin 27 of the station (E. S. R., 6, p. 240) and reprinted in Bulletin 31 (E. S. R., 6, p. 923).

The history of European domesticated cattle in its relation to the European people, WERNER (*Deut. landw. Presse, 23* (*1896*), *No. 58, pp. 516, 517, figs. 5*).

Are there characteristic differences in the finer structure of the muscles of the Breitenberger and Angler cattle which could be regarded as breed traits? C. NÖRMER (*Deut. landw. Presse, 23* (*1896*), *No. 54, pp. 481–483, figs. 5*).

The Channel Islands breed of cattle, J. L. THOMPSON (*Agl. Gaz. N. S. Wales, 7* (*1896*), *No. 9, pp. 612–618, pls. 2*).—A general description of these cattle.

Progress in cattle breeding and creamery work in Tyrol (*Milch Ztg., 25* (*1896*), *No. 24, p. 380*).

The question of similarity of purpose in the cattle raising industry in similar districts, A. ARNSTADT (*Deut. landw. Presse, 23* (*1896*), *Nos. 75, pp. 666, 667; 76, pp. 677, 678; 88, p. 785; 89, p. 795; 91, p. 811*).—A general discussion.

Types of Dutch cattle (*Milch Ztg., 25* (*1896*), *No. 24, p. 380, figs. 2*).

Slaughter tests and investigations in regard to the quality of the meat at the twenty-second fat stock show at Berlin, 1896, C. LEHMANN (*Deut. landw. Presse, 23* (*1896*), *Nos. 82, p. 736, figs. 9; 83, p. 742; 85, pp. 758, 759, figs. 12; 87, pp. 774, 775, figs. 6; 89, pp. 789, 790, fig. 1; 91, pp. 806, 807*).

The maintenance of the German sheep raising industry, ALBRECHT (*Fühling's landw. Ztg., 45* (*1896*), *No. 21, pp. 675-679*).—A general discussion.

Observations on the purity of breeding and descent of the Belgian draft horse, LEYDER (*Deut. landw. Presse, 23* (*1896*), *No. 78, p. 698*).

Observations on the purity of breeding and descent of the Belgian draft horse, M. FISCHER (*Deut. landw. Presse, 23* (*1896*), *No. 90, p. 800*).—A reply to the preceding article.

Fowls, care and feeding, G. C. WATSON (*U. S. Dept. Agr., Farmers' Bul. 41, pp. 24, figs. 4*).—The author discusses at length the construction and arrangement of poultry houses, selection of breeds, breeding, feeding, brooders and incubators, diseases of poultry, and dressing and shipping.

Turkeys as hatchers, S. CUSHMAN (*Rural New Yorker, 55 (1896), Nos. 2438, p. 698; 2439, pp. 714, 715*).—A general article stating that turkeys may be trained to hatch several broods in succession. The eggs may be of any sort. Turkeys and capons may be trained to act as mothers to young chickens.

Annual reports of the poultry and pet stock associations of the Province of Ontario, 1895 (*Ontario Dept. Agr., pp. 63, figs. 7*).

VETERINARY SCIENCE AND PRACTICE.

Parturient apoplexy of cows, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1895, pp. 138–143*).—Reprinted from Bulletin 35 of the station (E. S. R., 7, p. 249).

The production of immunity to hog cholera by means of the blood serum of immune animals. Anti-toxic serums for hog cholera and swine plague, E. A. DE SCHWEINITZ (*Centbl. Bakt. und Par. Med., 20 (1896), No. 16–17, pp. 573–577*).

Verminous bronchitis, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1895, pp. 130–138, figs. 3*).—Reprinted from Bulletin 35 of the station (E. S. R., 7, p. 249).

Glanders in horses and mules, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1895, pp. 155–158*).—Reprinted from Bulletin 35 of the station (E. S. R., 7, p. 252).

Hog cholera and other swine diseases, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1895, pp. 144–147*).—Reprinted from Bulletin 35 of the station (E. S. R., 7, p. 252).

The African rinderpest J. KIRK (*Nature, 55 (1896), No. 1412, pp. 53, 54*).

Tubercles in pigs fed on raw milk and whey, G. BECKER (*Deut. Fleischer Ztg., 1896, June 4; abs. in Milch Ztg., 25 (1896), No. 24, p. 384*).—Four pigs out of 22 from a creamery and cheese factory, which were slaughtered, were found tuberculous and the carcasses were destroyed. The lungs of the others which had not been so long on the diet of raw milk and whey were found infected.

Tuberculosis of cattle, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1895, pp. 147–154*).—Reprinted from Bulletin 35 of the station (E. S. R., 7, p. 251).

DAIRY FARMING—DAIRYING.

Chicago gluten meal vs. King gluten meal, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 228–230*).—An experiment was made with 4 grade cows in different stages of lactation, to compare Chicago gluten meal and King gluten meal. The test, which was preceded by a preliminary period of 7 days, was divided into 2 periods of 7 days each. Each cow was fed 4.5 lbs. of wheat bran and 18 lbs. of rowen hay per day. In the first period cows 1 and 3 were fed 4.5 lbs. of King gluten meal, and cows 2 and 4, 4.5 lbs. of Chicago gluten meal daily. In the second period the rations were reversed. The composition of the Chicago gluten meal and the King gluten meal is given. The results are expressed in tabular form.

"The cows consumed the same amount of digestible matter daily, [and] the daily yield of milk and the cost per quart were practically identical in each period.

"The Chicago meal was in its usual good condition. In spite of the fact that the King meal contained nearly 20 per cent of fat, no rancid odor or taste was noticed after the meal had been in the barn 6 months. Its mechanical condition was all that could be desired. The objection to feeding by-products especially rich in fat is that,

if they are fed alone in large quantities (above 3 qts. daily) or fed in combination with other material of a similar nature, the tendency is to cloy the appetite of the animal, or—in warm weather especially—to produce inflammation of the milk glands.

"In a daily grain ration of 9 lbs. we would not advise feeding over 3 or 4 lbs. of but one by-product having above 7 to 8 per cent of fat."

Chicago gluten meal vs. Atlas meal, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 231, 232*).—An experiment to compare Chicago gluten meal and Atlas meal was made with 4 grade cows. It was preceded by a preliminary test of 7 days and was divided into 2 periods of 10 days each. In the first period 2 cows were fed 4 lbs. of Chicago gluten meal and 2 others 4 lbs. of Atlas meal daily. During the second period the feed was reversed. In addition each cow received 4 lbs. of wheat bran, 5 lbs. of hay, and about 40 lbs. of corn-and-soja bean silage throughout the experiment. The composition of Chicago gluten meal and Atlas meal is given, and the results are expressed in tabular form.

"The cost and quantity of milk and butter fat are so nearly equal in each case as to be considered practically identical. If the quality of the Atlas meal is maintained, it can be regarded as an excellent food for milch cows and neat stock in general."

Soiling experiments with leguminous and cereal crops, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1895, pp. 77–92*).—This is a continuation of work previously reported in Bulletin 9 of the station (E. S. R., 4, p. 479). The object of the test was to compare the relative feeding value of green fodders high in protein with those low in protein.

Six ordinary grade cows bought from farms or from the college herd were divided into 2 lots of animals as nearly alike in yield of milk and butter fat as possible. Eight tests were made. The green fodders experimented with were as follows: Oats and peas, soja beans, clover rowen, cowpeas, rowen grass, barley and peas, oat fodder, Hungarian grass, and corn fodder. The quantities fed were 80 lbs. of corn fodder and 70 lbs. of the other fodders per head daily. The green fodders were usually cut and hauled to the stable every other day.

At the beginning of each feeding test both lots were fed on a leguminous ration during a preliminary period of 5 days. After this, lot 2 was fed a ration of cereal fodder, while lot 1 received the same ration as at first. These rations were fed for 2 weeks. The experiment proper covered only the last 9 days. At the close of the experiment each lot was fed a ration similar to that used in the preliminary test.

The digestibility of the green fodders was determined in experiments with sheep, reported on page 422, since it was more convenient to make digestion experiments with sheep than with cows. The amount of digestible nutrients and fuel value of the rations fed per cow per day were computed from the results of these digestion experiments.

Tables are given which show the yield and composition of the milk of each cow for each period.

The following are the total yields for the 2 lots for the periods during which the feeds were compared:

Yields of milk, butter, etc., on leguminous and cereal soiling crops.

	Milk.	Solids.	Fat.	Butter.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1, fed mainly on leguminous fodders	2,159	280	95	111
Lot 2, fed on cereal fodders	1,933	259	90	106
Difference	226	21	5	5

The following conclusions were drawn:

"The best results on quantity of products were obtained where rations with relatively large amounts of protein were fed. Although one-seventh larger rations of corn fodder were used than of those rations made up mainly of the legumes, the latter generally gave larger yields of milk, of butter fat, and of solids in the milk. . . .

"As a rule, the best crops for summer feeding seem to be those rich in nitrogenous matter, or protein. Although smaller crops are usually obtained with the legumes (clover, peas, soja beans, etc.) than with fodder corn, the fodder from the legumes is richer in nitrogen and protein, and a larger percentage of this protein is digested by the animals, and hence these fodders are of more value in the production of milk, cheese, butter, and beef.

"Owing to irregularities in pasture feed, caused mainly by frequent droughts, it becomes necessary to supplement such feed by the use of green fodders or silage, in order to prevent serious shrinkage in the amounts of milk, milk solids, and butter fat. A more extended use of fodder crops like the clovers, oats and peas, soja beans, cowpeas, and barley and peas, is a matter that should receive the careful attention of dairymen."

A study of rations fed to milch cows, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1895, pp. 41–76*).—This is a continuation of work previously reported in the Annual Reports of the station for 1893 and 1894 (E. S. R., 6, p. 458; 7, p. 603). Two 12-day tests were made of 4 herds on private farms, containing from 10 to 14 cows each, there being an interval of 2 weeks or more between the 2 tests. The method was the same as in previous studies. During the first test the rations fed by the farmers were studied and calculated, and suggestions were then made of changes to make the rations conform more closely to the feeding standards. After these changes had been made the second tests were made. Information was obtained regarding the number of animals, breed, age, approximate weight of each cow, number of months since last calving, yield and fat content of milk, and kinds and weights of food used. Samples of the feeding stuffs were analyzed, and the digestible nutrients in each ration were calculated.

The digestible nutrients and fuel value of the rations fed, the milk and butter produced, and the cost of the latter for each of the 4 herds are given in the following table:

Original and suggested rations fed to cows on 4 farms in Connecticut.

Herd.	Ration.	Average daily ration per 1,000 lbs. live weight.					Average daily yield of—		Average cost of food.		
		Digestible protein.	Digestible fat.	Digestible carbohydrates.	Nutritive value.	Fuel value.	Milk.	Butter.	Total per cow per day.	Per 100 lbs. of milk.	Per pound of butter.
		Lbs.	*Lbs.*	*Lbs.*		*Calories.*	*Lbs.*	*Lbs.*	*Cents.*		*Cents.*
D	Original	2.15	0.76	15.66	1:8.0	36,350	14.0	0.79	14.1	$1.01	18
	Suggested	3.48	.86	17.28	1:5.5	42,250	13.7	.76	15.1	1.10	20
E	Original	2.18	.81	18.25	1:9.2	40,850	17.9	1.02	18.4	1.03	18
	Suggested	2.41	.59	14.11	1:6.4	33,250	18.3	1.07	15.9	.87	15
F	Original	1.65	.82	13.57	1:9.3	31,800	17.8	1.01	15.1	.85	15
	Suggested	2.79	.94	13.13	1:5.5	33,550	18.5	1.04	18.0	.97	17
G	Original	2.76	1.36	12.69	1:5.7	34,500	17.7	.98	16.7	.94	17
	Suggested	2.79	1.11	12.89	1:5.5	33,850	15.4	.90	16.2	1.05	18

In addition to the above tests the results are cited of the previous experiments already referred to. In all these the digestible protein per 1,000 lbs. live weight ranged from 1.35 to 3.48 lbs., the nutritive ratio from 1:4.5 to 1:11.3, and the fuel value from 28,600 to 42,600 calories. The average amounts of nutrients per 1,000 lbs. live weight in these 34 rations were as follows:

Average of 34 rations fed to cows in Connecticut.

	Protein.	Fat.	Carbohydrates.	Nutritive ratio.	Fuel value.
	Pounds.	*Pound.*	*Pounds.*		*Calories.*
Concentrated food	1.62	0.55	4.93	1: 3.8	14,500
Coarse food	.82	.32	8.76	1:11.6	19,150
Total	2.44	.87	13.69	1: 6.4	33,650

The article discusses feeding standards and quotes at length from the previous experiments mentioned above. From their own experience the writers suggest the following modification of Wolff's standard:

Organic matter	pounds	25.00
Digestible protein	do	2.50
Digestible fat	do	0.5 to 0.80
Digestible carbohydrates	do	13.0 to 12.00

This gives a fuel value of 31,000 calories, and a nutritive ratio of 1:5.6.

"The experience of the last two years would indicate that in general it is more profitable to feed a cow in 'the flush' rather more protein than the suggested ration calls for. The very decided trend of these experiments is toward nitrogenous feeding."

The conclusions drawn from the tests were practically the same as those in previous years.

"In general, there was the largest yield of milk and the largest butter production with narrow rations, *i. e.*, those rich in protein. Wide rations—low in protein—did not, in these instances, favor large milk or butter production. . . . Narrow rations—rich in protein—were the more economical.

"Our farmers need to make a much closer study of the individual cows of their herds and to reject the unprofitable ones. The relative productiveness of cows can be easily and cheaply studied by the use of the Babcock milk test, together with daily weighings of the milk product.

"A closer study of the value and economy of the feeding stuffs produced on the farm is important. Such feeds as clovers, corn fodders, corn stover, oat hay, and peas and oats, should be more largely grown. These have little value in the markets, while for feeding many of them are fully equal to, and some more valuable than, the best grades of hay. When first-class hay sells for from $15 to $18 per ton, it is one of the most expensive dairy feeds.

"The nitrogenous (protein) feeding stuffs, like clovers, cotton seed, linseed, and gluten meals, should be more extensively used as dairy feeds. These feeds have been shown to exert a greater influence on the quantity and quality of animal products than corn and even wheat feeds, and when the manure is carefully saved they are of great value for keeping up the fertility of the farm."

Experiment in warming a stable for cows, W. P. BROOKS (*Massachusetts Hatch Sta. Rpt. 1895, p. 205*).—A test, lasting from December 18, 1894, to March 8, 1895, was made with 6 cows, divided into 2 lots of 3 each, on the effect of a warm stable in winter on the yield of milk and butter. One lot was kept in a stable heated by means of hot water pipes to about 55° F., and the other lot was kept in a stable not heated. The experiment was divided into 4 equal periods. At the end of the first period the lots were reversed, and reversed again at the end of the third period. In each case after the change the first week was regarded as a preliminary period.

"The apparent influence of the warm stable upon milk and butter fat production is small. On the average, there is rather more milk and butter fat in the warm stable. The most certain effect brought out by our experiments is the lowering of the percentage of fat in the milk in the warm stable. The increased product will not nearly pay the cost of heating the stable.

"With moderate artificial heat better ventilation can be secured, without making the stable too cold for the comfort of its occupants, than is possible without artificial heat."

A year's experience with Bacillus No. 41 in general dairying, H. W. CONN (*Connecticut Storrs Sta. Rpt. 1895, pp. 17–40*).—Following the laboratory trials with the author's Bacillus No. 41, the attempt was made to test its applicability in general dairy work. Certain difficulties were anticipated in this, among others the general carelessness in many creameries, mistakes in handling the culture, and the bacteria already present in the cream. It was impossible, except in a few cases, for the author to control the work at the creameries where these trials were made, and it was necessary for him to prescribe certain rules for guidance in the use of the culture, although it was realized that no definite rules could be formulated which would apply to all conditions. The danger was that butter makers would follow the directions so closely and blindly that in certain conditions of weather the cream

ripening would be a failure. No little difficulty has been experienced in preparing the pure cultures on a large scale without their becoming contaminated and in recognizing contaminated cultures quickly. Many of these difficulties have, however, been overcome.

The cultures had been in the hands of dairymen about a year at the time of writing, and the article reviews the successes and failures.

"The great majority of the testimony that has reached me as the result of the year's experiments has been of a highly satisfactory character. In some cases, indeed, an improvement is seen from the first, in others the first inoculation has produced no effect, but a second one has followed and has been successful. Nearly all who have persevered in their use of the organism have obtained satisfactory results. . . .

"In the great majority of cases creameries have been able to command a price varying from a half a cent to 2 cents a pound more for the 'culture' butter than for the butter made at the same time without the culture; and while this is certainly not a universal verdict, it has been obtained in so many cases as to show the possibility that lies in this line of butter making. . . .

"Something over 200 creameries have, during the past year of experimenting, used this Bacillus No. 41 with success. The success has, it is true, been varied; some reaping a considerable financial profit therefrom, while others have been less fortunate. These creameries are most of them still continuing the use of the culture—over 200 using it at the present time. They are distributed all over the dairy section of our country, among no less than 13 States. Some of them have used the organism now for 8 or 9 months, others for 6 months, others for 2 or 3 months, while some have only used it for a few weeks, at the time of writing. It is the most conclusive evidence of the value of Bacillus No. 41 that those creameries which have used the culture the longest are the most confident of its value. Creameries which have used the culture for 6 or 8 months, until they have become thoroughly familiar with its action and with the proper method of its use, are the most certain that they are reaping a decided and a constant advantage from it. Those that have used it in a single experiment, or only a very short time, are the ones that are the most doubtful as to its advantage to them."

Aside from the improved flavor, the indications presented appear to be that the culture improves the keeping quality of the butter. This is based on the testimony of commission merchants.

"The peculiar, delicate flavor which appears at first does not disappear at once, and commission merchants in New York and Boston have stated that 'culture' butter 2 weeks old still retains its fresh, quick flavor, and can be sold at the top of the market, whereas ordinary butter will in that time have lost a little of its delicate flavor and must be sold a little under the top price."

Although the data upon the subject are yet meager, in some instances it has appeared that "'culture' butter after being 2 months in cold storage has been actually of a better flavor than when first put in." In a number of cases bad flavors and tastes in the cream and the resulting butter have been eliminated by using the culture.

As was expected, the use of the culture has not proved of any advantage in some cases. These failures have, so far as the author knows, been confined almost exclusively to trials of short duration. A common method of testing the culture is to divide the cream into two parts, using the culture in one part and allowing the other part to ripen normally. The author objects to this kind of test, and states

that it does not give conclusive results, "since a small lot of this sort does not give the organisms a fair showing." Some of the failures have been explained by lack of proper handling of the cultures or too short trials, but in other cases they can not be fully explained, although no failures have occurred in creameries where the author has been able to personally superintend the introduction of the culture.

"Many facts in regard to the practical methods of using the culture are being constantly learned. The best temperature for ripening at different seasons, the best temperature for churning, the proper proportion of the culture to add to the cream, the best time to add it, etc.; all these are matters of practical importance and must be learned by practical experience before perfect success can be expected. Thus far in the year's experience it has appeared that, as the butter makers do learn these facts and get more familiar with the method, the failures in many cases give place to success, and the lack of thorough adaptation of the method to the creamery is the cause of most of the lack of success. Undoubtedly also some of the failures in these 'sample trials' have been due to molds or other contaminations which occurred in the culture and ruined the value of the sample, and thus spoiled the experiment. Such troubles will not occur hereafter, because of improved methods of preparation of the cultures. . . .

"There may be creameries and conditions under which this culture will not produce its ordinary effect, and this can only be determined by a continuation of such experiments. The attempt is now being made to keep closer watch of the experiments in order to learn, so far as possible, the causes and remedies for the failures. New methods of use are being devised by the dairymen, and in a few months it will be possible to determine with more certainty how generally it will be possible to avoid failure and insure success by improved methods of handling."

The following is the method which has been adopted for the introduction of the culture into the cream: Pasteurize 6 qts. of cream by heating (at 155° F.) and after cooling dissolve in this the pellet containing the culture; set in a warm place (70° F.) and allow the culture to grow for 2 days, and then inoculate in 25 gal. of ordinary cream; allow this to ripen as usual, and then use it as a starter in the large cream vats in the proportion of 1 gal. of starter to 25 gal. of cream. The whole is ripened at a temperature of about 68° F. for one day.

The experience of butter makers in the past year has taught many secondary facts regarding the best methods of handling the culture in ripening cream. It has appeared, for instance, that cream ripened with this culture should be churned at a little lower temperature than ordinary cream to give the best results as to body, grain, and flavor. A temperature as low as 52 to 54° is sometimes needed. It has been found possible to keep cream sweet for a longer period by the use of the culture than without it. In laboratory trials cream has been kept for nearly 2 weeks without becoming sour. Hence the buttermilk from such cream is sweeter and keeps for a longer time than ordinary buttermilk.

Cream from different patrons of the same creamery has been found to differ in character, and in some cases it has been found best to use specially selected cream for making up the first starter. In pasteurized cream a higher temperature is required for ripening the cream with

Bacillus No. 41 than without it in order to give the proper flavor and acidity. In some cases of this sort a temperature as high as 80° has been used with success.

The advantage from using Bacillus No. 41 has been sometimes greater in gathered-cream creameries than in those where the milk is brought to the creamery for separation, since in the case of gathered cream the cream is not fresh when received at the creamery and the ripening process has already commenced and occasionally the cream is sour.

"The use of Bacillus No. 41 has been found during the last year largely to obviate this irregularity in the gathered-cream system. . . . It has been found very advantageous to place 2 or 3 qts. of the Bacillus No. 41 starter in the cream collector's cans before he starts on his rounds, in order that the organism may get a longer chance to grow in the cream. With this procedure the culture begins to do its work as soon as the cream is poured into the cans."

In conclusion the author expresses the belief that the experience of the past year has been sufficient to indicate beyond question that the method of using pure cultures or some kind of bacterial starter is correct in principle and will be the coming method in dairying for the purpose of producing high flavor and uniform quality in butter. He does not claim it to be proved that Bacillus No. 41 is the best organism that can be used for this purpose, or that some other culture composed of a mixture of two or more different species of bacteria may not be found which will be, on the whole, more advantageous than Bacillus No. 41.

Experiments in ripening cream with pure cultures, SARTORI (*Abs. in Milch Ztg., 25 (1896), No. 43, pp. 685, 686*).—These experiments were made at the request of the Italian Minister of Agriculture in the creamery of the Royal Agricultural School at Brescia. The cream was first pasteurized, and as soon as it had cooled to the proper temperature the pure culture was added. As to the extent of ripening, the author finds that an acidity equal to 28 to 30 cc. of $\frac{1}{4}$ normal alkali is best for butter which is to be kept some time, although a lower acidity (25 to 27 cc.) gives more aroma and is preferred for butter that is to be consumed at once.

The butter made with pure cultures was of excellent quality, with good aroma, and was preferred by nearly all who sampled it to the common sweet-cream butter. Such butter retained its fresh taste and its aroma much longer than sweet-cream butter. Numerous instances of this are cited.

It is suggested that by means of pasteurization and pure cultures the quality of the butter made from sheep's milk might be improved and its peculiar unpleasant taste removed or prevented.

A new fungus in butter, G. W. SHAW (*Oregon Sta. Press Notes, Nov. 23, 1896*).—"There have been several instances reported in Portland of apparently good butter turning to a bluish-black color on the outside, beginning in several isolated spots and gradually extending over the entire surface." Three rolls of such butter examined for adultera-

tion showed no foreign fats; but an unknown fungus was found on the affected portions. It was sent to this Department for examination, where it was identified as a new species of mold, and named *Stemphylium butyri*. Another instance of its occurrence is noted in some butter from North Carolina. In this case "the disease seems to have been introduced from the paper used in wrapping."

Acidity of milk increased by boracic acid, E. H. FARRINGTON (*Jour. Amer. Chem. Soc., 18* (*1896*), *No. 9, p. 847*).—The author found that a given amount of "preservaline" increased the acidity of milk 4 times as much as it did that of a like quantity of water. He is unable to explain the reaction, but recognizes in it a simple means of detecting boracic acid or preservaline in milk, as 1 gm. of the latter per liter of milk gives an acidity equivalent to sour milk.

On a fraud in milk, E. H. JENKINS (*Connecticut State Sta. Rpt. 1895, pp. 214, 215*).—Several samples of milk from a single dairy were found to be much below the normal for whole milk, resembling watered milk. It was learned subsequently that "when the cows were about half milked, the calves were turned in to feed and finish the milking." Several analyses showing the composition of the milk from the first and last part of the milking are quoted:

"Allowing calves to take a part of the milk is a common and, in itself, proper practice; but anyone who sells the first of the milking as whole milk grossly defrauds the purchaser. This case is interesting in calling attention to a possible dishonesty which is not always fully and certainly met by legislation."

The [Thistle] milking machine at Fritzow, Colberg, LINDENBERG (*Milch Ztg., 25* (*1896*), *No. 28, p. 446*).—The working of the machine is described (see E. S. R., 7, p. 70). After using it for 2 months, the writer states that although he was somewhat skeptical at first, he is thoroughly convinced of its utility. Ten cows are milked at once, requiring about 5 minutes. For milking 82 cows only one man and a boy are required. The milking is entirely satisfactory, and the yield of milk has increased over hand milking. No trouble has been had with the machine from the first day. It is believed that it will pay for itself in a year.

Butter tests of Jersey cows at the show of the Royal Jersey Agricultural Society (*Milch Ztg., 25* (*1896*), *No. 29, p. 462*).—At the show held on the Island of Jersey in May, 1896, 17 cows were entered in the 24-hour butter test. The milk was creamed by a hand separator, and the cream churned the next morning.

The results for the 3 cows taking the gold, silver, and bronze medals were as follows: Milk yield—Fancy 8,007, F. S. H. C., 47 lbs. 6 oz.; Mariette 5,535, P. S. C., 47 lbs. 2 oz.; Cunning Fox 6,338, F. S. C., 44 lbs. 10 oz. Butter yield—3 lbs. 3¼ oz., 2 lbs. 12¼ oz., and 2 lbs. 8¼ oz., respectively. Amount of milk required to make 1 lb. of butter—14.79 lbs., 17.03 lbs., and 17.73 lbs., respectively.

The preservation of butter, V. VON KLECKI (*Oesterr. Molk. Ztg., 1896, Nov.; abs. in Milch. Ztg., 25* (*1896*), *No. 45, p. 717*).—The author

describes the Backhaus-Schachsche method, as follows: The butter is melted, strongly salted, and packed in tubs. When it is to be marketed, it is emulsified with milk and churned again. The great advantage which would result if butter could be kept in first-class condition for a considerable time is pointed out. The author believes that the preservation of the good qualities must be studied scientifically, and that the question of butter faults and the preservation of butter without change offers a splendid field for investigation.

What constitutes a "space" of cream? J. B. LINDSEY and G. A. BILLINGS (*Massachusetts Hatch Sta. Rpt. 1895, pp. 233–236*).—The milk of 6 new milch cows was set in cold deep setting (38 to 40° F.) on 2 or 3 days, and the results estimated in spaces of cream, as is customary in the cream-gathering system. A summary follows:

Yield and fat content of milk and spaces of cream.

	Average daily yield of milk.	Average fat content of milk.	Average daily yield of fat.[1]	Spaces of cream per day.	Average fat content of cream.	Average fat content of skim milk.
	Pounds.	*Per cent.*	*Pounds.*		*Per cent.*	*Per cent.*
Cow No. 1	25.80	4.0	1.03	7.80	16.53	0.17
Cow No. 2	22.08	4.0	.88	5.57	16.45	.56
Cow No. 3	26.30	4.2	1.10	11.30	11.98	.27
Cow No. 4	26.02	5.0	1.30	8.20	21.70	.17
Cow No. 5	29.31	3.0	.88	7.05	15.95	.16
Cow No. 6	31.31	5.0	1.57	9.85	19.85	.13

[1] Added by abstractor.

Cows Nos. 1, 2, and 5 produced the smallest number of spaces of cream, containing from 16 to 16½ per cent of fat. Cow No. 3 produced over 11 spaces of cream with 12 per cent of fat, No. 6 produced 9.85 spaces with nearly 20 per cent, and No. 4 produced 8.2 spaces with nearly 22 per cent of fat.

A simple calculation shows that the space included all the way from 0.63 to 1.03 lbs. of fat in different cases.

Low temperature pasteurization of milk at about 68° C. (155° F.), R. G. FREEMAN (*Arch. Pediatrics, 13 (1896), No. 8, pp. 595–606, figs. 4, chart 1*).—A carefully compiled table is given of the thermal death point, in a moist medium, of certain pathogenic bacteria. From the evidence the auther concludes that a temperature of 65° C. for 15 minutes is sufficient to kill tubercle bacilli. Accordingly he fixed upon a temperature between 65 and 70° for the pasteurization. He makes the objection to the use of a thermometer in pasteurizing milk that it "gives good results only when very carefully watched. It is moreover very difficult even when watching a thermometer to bring a fluid to any fixed temperature and hold it at that temperature for half an hour."

The apparatus which he has devised consists of a pail and a removable receptacle for the bottles of milk, consisting of a series of zinc cylinders closed at the lower end. Water is filled in the pail to a mark and then brought to boiling. Meantime the milk is filled in the bottles,

which are stoppered with cotton and then placed in the cylinders. Sufficient water is poured into each cylinder to surround the body of the bottle, and the receptacle is then placed in the pail, which is removed from the stove, the cover quickly replaced, and the whole allowed to stand for three-quarters of an hour. A support for the receptacle is at such a height that the lower inch of the cylinders is immersed in the water. "During the first 15 minutes the temperature of the milk rises to . . . about its maximum, or above 65°, the point desired for pasteurizing, and remains there the remaining 30 minutes. During the last 15 minutes it falls about 1°." At the end of the 45 minutes the cover is removed, the receptacle is lifted so that it rests on a higher support, raising the tops of the cylinders above the top of the pail, and cold water run into the pail and allowed to overflow. In about 15 minutes the milk in the bottle is said to be about the temperature of the cold water and the bottles are removed and placed in a refrigerator.

A chart is given showing the changes in temperature of the milk during the operation, and the author calls attention to the following points:

"(1) The apparent lack of precision in the action of the apparatus, due to the unknown temperature of the milk introduced, is to a considerable extent corrected. The amount and temperature of the boiling water used for heating is definite; the amount of cold milk to be heated is definite, but the temperature of the milk is such as may be covered by the word cold or by refrigerator temperature. The chart shows that the apparatus will correct a considerable variation of the temperature of the milk used by the ability of the boiling water to carry cold milk through a greater number of degrees of temperature than warmer milk; on this account whether the milk is introduced at a temperature of 10° C. (50° F.) or 20° C. (68° F.), the resultant temperature varies only 2° C.

"(2) The very rapid rise in the temperature of the milk introduced. It rises about 35 or 40° in the first 5 minutes, about 10° in the second 5 minutes, and about 5° in the third 5 minutes.

"(3) The even temperature preserved after the rise; a variation of not more than a degree during the last 25 minutes.

"(4) The rapid fall of the temperature in a cold-water bath; a fall of about 35° in the first 5 minutes. This cooling in a cold-water bath takes places 8 times as fast as in a refrigerator."

Facts about milk, R. A. PEARSON (*U. S. Dept. Agr., Farmers' Bul. 42, pp. 28, figs. 8*).—This is a popular presentation of certain facts in regard to the extent of the dairy industry of the country; the physical and chemical character of milk; the changes in milk; difficulties of obtaining pure milk; adulteration; preservatives; care of milk, including description of the method for pasteurization previously described in a circular of the Department; various methods for detecting adulteration of milk; care of milk on farms; transportation of milk; and its delivery in cities, together with certain suggestions for improvement.

The author advocates selling milk on the basis of its quality, the price being in proportion to the fat content.

"The grades of milk should be numbered with the whole numbers nearest to the percentage of fat content. Thus a separator skim milk with but a trace of fat would

be '0.' Skim milk having from ½ to 1½ per cent of fat would be '1,' and so on. Whole milk would be of 3 grades, '3,' '4,' and '5,' and extra rich or 'fortified' milk (to which cream has been added) would be '9' or '10.' Cream would run from '13' to '50.' No more grades of milk and cream need to be carried than is the custom now, but each should be marked with its appropriate number. While the idea of the percentage of fat thus indicated might not be clear to all, it would soon be understood that the higher numbers meant the richer milk. If this practice were observed it would be difficult for the drivers to tell their customers one thing and the milk inspector another about the quality of the contents of the same can. The signs should be so attached to the wagon side or can that they could not be easily changed. If bottles were used the number representing the quality should be attached to each one."

Milk as an agency in the conveyance of disease, R. G. FREEMAN (*Med. Rec., 49* (*1896*), *No. 13, pp. 433–443, figs. 7*).—The author discusses the magnitude of the milk traffic and the sources of contamination of milk.

Three Petri plates 3½ in. in diameter, containing a layer of sterilized nutrient gelatin, were exposed for 2 minutes each on the farm of a gentleman near New York, one being exposed out of doors, a second in the barn, and a third under a cow just in front of the milk pail during milking. Subsequent examination showed that the plate exposed out of doors received 6 bacteria, that exposed in the barn 111, and that exposed under the cow 1,800.

In an experiment on the effect of temperature on the growth of bacteria in milk a certain amount of milk was put in 4 sterilized test tubes which were kept for 24 hours at different temperatures, and at the end of that time plate cultures were made from a sample from each tube. The following is the number of colonies which developed in each case: Tube kept at 7° C. (45° F.), 45 colonies; at 10° C. (50° F.), 1,362; at 13° C. (55° F.), 67,170; at 20° C. (68° F.), 134,340.

The diseases conveyed by milk are next discussed under the headings (1) Diseases conveyed by milk from a diseased cow, (2) Diseases conveyed from one human being to another by milk, and (3) Diseases caused by milk which contains poisonous agents developed by bacterial growth.

The data are tabulated for 53 epidemics of typhoid fever attributed to milk, 26 of scarlatina, 11 of diphtheria, 2 of foot-and-mouth disease, 3 of throat affection, 2 of acute poisoning by milk, and 1 of Asiatic cholera. Only those occurring since 1880 are included. Cases of the transmission of these diseases and of tuberculosis, anthrax, and acute enteritis, and the danger from this transmission are discussed.

"In summing up we may conclude that infection by milk is well established in typhoid fever, scarlatina, diphtheria, tuberculosis, cholera, foot-and-mouth disease, and acute enteritis, and that it may exist in anthrax. Cases of acute poisoning from milk by some undetermined agent also occur. Medical literature furnishes us with reliable evidence of an immense amount of sickness and a considerable death rate caused by milk. The recorded epidemics are but a part of those which occur. Many epidemics are never traced to their source, and some which are so traced are not reported. This sickness and death directly due to contaminated milk is to a great extent preventable by proper legislation concerning the inspection of dairies and the handling of milk.

"A study of these epidemics teaches us that—

"(1) Whenever a case of communicable infectious disease is reported inquiry into the source of the milk supply should be made.

"(2) Milk traffic should be separated from houses where people live. The dairy building should be at least 100 ft. from either the house, barn, or privy, and should be on a higher level than any of these, and should have a pure water supply of its own. At this dairy building all the dairy work should be done, including the cleansing of pails and cans.

"(3) It should be unlawful for anyone who has come in contact with a sick person (when this sickness is not positively known to be noncontagious) to enter the dairy building or barn, or to handle the milk.

"(4) All men connected with the milk traffic should be compelled to notify the authorities on the outbreak of any disease in their respective abodes, and to abstain from their work until permission to resume is given them by the authorities notified.

"(5) Cities should accept milk only from dairies which are regularly inspected, where all the cows have been tested with tuberculin and those giving the characteristic reaction have been killed and the premises disinfected.

"(6) The tuberculin test should be applied to all cattle, and those which react should be killed, the owner being reimbursed from State funds. The premises on which such tuberculous cattle have been kept should be thoroughly disinfected. All cattle which are brought into the State should be quarantined until the tuberculin test has been applied.

"(7) The use of one long trough for the purpose of feeding many cattle should be avoided, since it is a ready means for the conveyance of pathogenic germs from one animal to another."

At what age should heifers be bred? A. GOUIN and H. GEORGE (*Jour. Agr. Prat., 60 (1896), No. 46, pp. 713, 714*).—General discussion of the subject.

Bananas for cow feed, A. H. POLK (*Florida Farmer and Fruit Grower, 8 (1896), No. 38, pp. 595, 596*).—Cows ate freely the cured leaves, stalks, and roots of bananas which had been injured by a frost. The author recommends feeding the roots of bananas which have ripened fruit. The stumps were sliced for feeding. The cows were fed banana roots during the winter and very little other food. In the author's opinion their milk yield was increased and was of the best quality.

The effect of peat-molasses feed and of ruta-bagas on the qualities of the butter, LASSEN (*Milch Ztg., 25 (1896), No. 24, p. 382*).—Cases are cited from practice in which the butter produced when the molasses feed was fed moderately gradually became oily and of inferior quality, and when fed with only a small ration of grain was almost unsalable. The bad effects were persistent for some time after the molasses feed was dropped, and in the latter case did not disappear until the cows were turned to pasture. Instances of injury to the butter from feeding ruta-bagas are also given.

Economic feeding of milch cows, J. B. LINDSEY (*Massachusetts Hatch Sta. Bul. 39, pp. 23*).—The author discusses the principles of nutrition, rations, and composition of milk. A table showing the composition, digestibility, and fertilizing value of the most important cattle feeds is given.

Determination of yield of butter fat by cows to aid in breeding good milch cows, H. WEIGMANN (*Landw. Wochenbl. Schles. Holst., 46 (1896), Nos. 32, pp. 459–461; 33, pp. 473–475*).

Milk record of a herd (*Milch Ztg., 25 (1896), No. 44, pp. 704, 705*).—A record for 1895–'96 for the Kleinhof-Tapiau herd of 104 East Prussian Dutch Cows.

Milk yield of Oldenberger cows (*Oesterr. Molk. Ztg., 1896, Sept.; abs. in Milch Ztg., 25 (1896), No. 42, p. 669*).—Record for one year of 9 cows.

Trial milkings of Algäuer cows (*Mitt. des milchw. Vers. in Algäu, 7 (1896), No. 5; abs. in Milch Ztg., 25 (1896), No. 34, p. 539*).

Effect of working cows on the quality of the milk, P. DORNIC (*Ind. Lait., 21 (1896), No. 15, pp. 113–115*).

The De Laval milking machine, P. DORNIC (*Ind. Lait., 21 (1896), No. 26, pp. 201, 202*).

The Thistle milking machine (*Milch Ztg., 25 (1896), No. 42, pp. 669, 670, figs. 2*).

The profitableness of keeping milch cows, A. ANDRÉ (*Deut. landw. Presse, 23 (1896), No. 84, p. 753*).

Sheep's milk from some non-milk breeds, HUCHO (*Milch Ztg., 25 (1896), No. 33, pp. 521, 522*).—A number of analyses are given of the milk of 2 Merinos, 1 Hampshire, 1 Rhönschaf, and 1 Heidschnucke, taken at different stages of lactation, and these are discussed.

Artificial human milk, P. VIETH (*Milch Ztg., 25 (1896), No. 32, pp. 505–507*).—General article on the difference between cows' milk and human milk in composition and in the nature of the constituents, and the attempts which have been made to approximate human milk.

Distinction between raw and cooked milk, OSTERTAG (*Ztschr. Fleisch- und Milchhyg., 7 (1896), No. 1, pp. 6–9*).

The nature of the poisonous action of peptonizing bacteria in milk, A. LÜBBERT (*Ztschr. Hyg., 22 (1896), p. 1; abs. in Chem. Ztg., 20 (1896), No. 66, Repert., p. 207; and Milch Ztg., 25 (1896), No. 34, p. 540*).

The origin of the natural acidity of milk, P. DORNIC (*Ind. Lait., 21 (1896), No. 41, pp. 321, 322*).

Preservation and analysis of samples of milk, P. DORNIC (*Ind. Lait., 21 (1896), Nos. 34, pp. 265, 266; 35, pp. 273, 274*).

Sterilizing milk, PELLERIN and LEZÉ (*Jour. Agr. Prat., 60 (1896), I, No. 25, pp. 890, 891*).

A self-regulating pasteurizing apparatus, and the importance of milk pasteurization from a pathogenic standpoint (*Ugeskr. Landm., 1896, No. 39; abs. in Milch Ztg., 25 (1896), No. 42, p. 670, figs. 3*).

The use of the acidimeter for detecting milk which has undergone or is undergoing change, P. DORNIC (*Ind. Lait., 21 (1896), No. 45, pp. 353, 354*).

A convenient milk-sampling tube, M. A. SCOVELL (*Kentucky Sta. Rpt. 1895, pp. XXVI–XXXII, pl. 1*).—A reprint of a paper read before the Society for the Promotion of Agricultural Science and published in *Agricultural Science, 8 (1894), No. 6–9* (E. S. R., 6, p. 674).

Pure cultures for ripening cream (*Milch Ztg., 25 (1896), No. 24, p. 382*).—The Dairy Institute at Kiel, which has been furnishing the pure cultures in liquid form, will now put them up in solid form, as it is becoming more and more apparent that the solid form is the best.

The relation of pure cultures to the acidity, flavor, and aroma of butter, H. W. CONN (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 13, pp. 409–415*).

The rôle of ripening in butter making, P. DORNIC (*Ind. Lait., 21 (1896), No. 17, pp. 129, 130*).

Coöperative creameries in France (*Milch Ztg., 25 (1896), No. 30, pp. 475, 476*).

Progress of the dairy industry in Switzerland, P. DORNIC (*Ind. Lait., 21 (1896), Nos. 36, pp. 281, 282; 37, pp. 289, 290*).

The development of the creamery industry in Denmark (*Milch Ztg., 25 (1896), No. 28, p. 445*).

Factory records of 2 farm and 7 coöperative creameries in Mecklenburg-Schwerin for 1895, J. SIEDEL (*Milch Ztg., 25 (1896), No. 27, pp. 427–429*).

Bacteria in the dairy (*Connecticut Storrs Sta. Rpt. 1895, pp. 14–16*).—A short reference to the work during the past 8 years by H. W. Conn, published mostly in the bulletins and reports of the station.

Trials with the use of different pressure in making Gruyère cheese, C. MARTIN (*Ind. Lait., 21 (1896), No. 19, pp. 137, 138*).

A report on the manufacture of cheese from soft curd (Camembert and Brie), M. DE METALNIKOFF and M. V. HOUDER (*Bul. Min. Agr. France, 5 (1896), No. 4, pp. 512–543, figs. 24*).

The manufacture of cheese known as Port-l'Évêque, P. DORNIC (*Ind. Lait., 21 (1896), No. 22, pp. 169, 170; abs. in Milch Ztg., 25 (1896), No. 34, p. 542*).

Dairy products, J. B. LINDSEY ET AL. (*Massachusetts Hatch Sta. Rpt. 1895, pp. 226, 227*).—Eighty-seven samples of milk, 18 of cream, and 28 of butter have been analyzed during the year. Instructions for sending milk are given, and the composition of milk, deep-setting and separator skim milk and cream, and buttermilk is quoted.

The book of the dairy, W. FLEISCHMANN, trans. by C. M. Aikmann and R. Patrick Wright (*London: Blaikie & Son, 1896; reviewed in Mark Lane Express, 75 (1896), No. 3388, p. 382, and Agl. Gaz., London, 44 (1896), No. 1186, p. 258*).

TECHNOLOGY—AGRICULTURAL ENGINEERING.

Sirup and molasses, G. L. TELLER and J. F. MOORE (*Arkansas Sta. Rpt. 1895, pp. 181–186*).—A reprint of Bulletin 37 of the station (E. S. R., 7, p. 992).

Farm drainage, C. L. NEWMAN (*Arkansas Sta. Rpt. 1895, pp. 33–54, fig. 1*).—A reprint of Bulletin 32 of the station (E. S. R., 6, p. 942).

On the use of iron plows in the ceded districts of Madras, C. K. SUBBA RAS (*Dept. Land Records and Agr., Madras (Agl. Branch), II, No. 33, pp. 15–17*).—Large iron plows were compared with the heavy wooden plows common in this region. The results were very favorable to the iron plows.

Heel scrape and scooter, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1895, pp. 28–31*).—Reprinted from Bulletin 31 of the station (E. S. R., 6, p. 942).

Road bulletin, A. W. CAMPBELL (*Ontario Dept. Agr., Road Bulletin 2, pp. 15, figs. 5*).—A general discussion of road labor and expenditure in Ontario, road drainage, forming a roadbed, road metal, rolling, tires, culverts, bridges, fences, road machinery, and residential streets of towns.

STATISTICS.

Acreage, production, and value of principal farm crops in the United States, 1866–1895, with other data as to cotton and wool (*U. S. Dept. Agr., Division of Statistics Circ. 1, pp. 8*).—This circular consists of tables compiled mainly from data collected by this Department. The additional matter relating to cotton is the world's consumption of cotton by years, 1880 to 1895; cotton production by countries in 1834 and 1892, and the world's cotton crop by years, 1865 to 1895. The prices of the 3 grades of domestic fleece wool in the seaboard markets are given for each quarter of the years 1852 to 1895, and the average prices of mess pork per barrel in New York for the years 1866 to 1895.

Number and value of farm animals of the United States and animal products, 1880 to 1896 (*U. S. Dept. Agr., Division of Statistics Bul. 11, misc. ser., pp. 63*).—A history of the changes in number and value of the horses, mules, cattle, sheep, and swine of the country during the years 1880 to 1896; tables giving total value of all farm animals, number and value by States and Territories, percentage of annual increase or decrease for the whole country and by States and Territories, average value by geographical divisions, and losses of farm animals by years; and discussions upon the number and value per farm and percentage of increase or decrease from 1880 to 1890, relation of farm animals to population, relation between total value and value of each class, exports of farm animals and meat products; production, imports, exports, and consumption of wool, and farm animals of the world.

Railway charges for the transportation of wool (*U. S. Dept. Agr., Division of Statistics Bul. 10, misc. ser., pp. 30*).—This includes tables showing the amount of

wool produced and consumed in each State and Territory as given by the Census of 1890, amount transported in each of 10 groups of States, an explanation of the freight classification of wool, tables showing rates from 12 important shipping points to about 40 markets, and rates within 15 of the most important wool growing States. The text is mostly explanatory.

Report of the director of Arkansas Station for 1895 (*Arkansas Sta. Rpt. 1895, pp. 1, 2*).—A list of the bulletins published during the year, brief remarks, and a financial statement for the fiscal year ending June 30, 1895.

Reports of board of control and treasurer of Connecticut State Station, 1895 (*Connecticut State Sta. Rpt. 1895, pp. XX, 302–305*).—Brief notice by the secretary of the board of control upon work in different lines, and publications issued during the year; and the report of the treasurer for the fiscal year ending September 30, 1895. Recent legislation affecting the station is also given.

Reports of director and treasurer of Connecticut Storrs Station, 1895 (*Connecticut Storrs Sta. Rpt. 1895, pp. 6–13*).—This includes a general review of the lines of work carried on during the year, and a financial report for the fiscal year ending June 30, 1895.

Eighth Annual Report of Kentucky Station, 1895 (*Kentucky Sta. Rpt. 1895, pp. LXVI, 148, pls. 6, figs. 9*).—Financial statement for the fiscal year ending June 30, 1895; report of director giving changes in organization and list of publications, and briefly outlining work of the year; reports of different divisions, including some new work, which is noticed elsewhere; and reprints of bulletins issued during the year.

Eighth Annual Report of Maryland Station, 1895 (*Maryland Sta. Rpt. 1895, pp. 218–239, pls. 4*).—Outlines of the work of the year by the director, chemist, horticulturist, and physicist; and a financial statement for the fiscal year ending June 30, 1895.

Report of the director of Massachusetts Hatch Station for 1895 (*Massachusetts Hatch Sta. Rpt. 1895, pp. 169–172*).—This contains a brief history of the two stations in Massachusetts, their consolidation, and the text of the act of the State legislature regarding it, the reorganization of the station, and a financial statement for the Hatch fund for the fiscal year ending June 30, 1895.

Report on work at the Gembloux agricultural experiment station during 1895, A. PETERMANN (*Ann. Sci. Agron., ser. 2, 1896, II, No. 2, pp. 238–252*).

Report on work at the agricultural experiment station in the Island of Mauritius during 1895, P. BONÂME (*Ann. Sci. Agron., ser. 2, 1896, II, No. 2, pp. 265–320*).—Meteorological observations; laboratory work; tests of fertilizers, especially on sugar cane, the utilization of molasses as a food, as a fertilizer, as fuel, and for the manufacture of salts and alcohol; and experiments with potatoes (varieties, planting, fertilizers, etc.).

The Rothamsted experiments, 1896 (*pp. 15, figs. 7*).—This gives plans and summary tables arranged for reference in the fields.

Memoranda of field and other experiments at Rothamsted, 1896, J. H. GILBERT (*pp. 107, figs. 7*).—This is the usual annual memoranda on the origin, plan, and results of experiments on the farm and in the laboratory, including the data obtained during the fifty-third year, and accompanied by a list of the papers which have been published on these experiments.

Conservatism in scientific agriculture, W. H. JORDAN (*Trans. Mass. Hort. Soc., 1896, I, pp. 31–47*).

NOTES.

MAINE STATION.—Ora W. Knight has been appointed assistant chemist and Prof. G. M. Gowell agriculturist, the appointments to date from December 1, 1896, and January 1, 1897, respectively.

NEW HAMPSHIRE COLLEGE AND STATION.—Hon. Frank Jones, of Portsmouth, has been appointed to the board of control, *vice* Henry W. Keyes, of Haverhill, whose term expired. Prof. J. W. Sanborn, formerly president of the Utah Agricultural and Mechanical College, now of Gilmanton, New Hampshire, has been appointed to the board of trustees of the college.

A forcing house, 100 by 25 ft., and potting house, 40 by 20 ft., are nearly completed. The cost will be $1,500, defrayed by a special appropriation from the State. These will be used for instruction and experimental work. An insectary is to be arranged in a portion of the old forcing house.

NEW YORK CORNELL STATION.—Edward A. Butler has been appointed clerk of the station, *vice* H. W. Smith, resigned. Prof. E. G. Lodeman, assistant in horiculture, died at Mexico, New York, December 2.

OREGON STATION.—The station has begun to issue "Press Notes" each month.

PENNSYLVANIA STATION.—R. J. Weld, a graduate of the short course in agriculture in 1892, has been temporarily employed as assistant to the director in place of E. H. Hess, who has been detailed for work at farmers' institutes.

SOUTH CAROLINA STATION.—Prof. W. L. McGee died October 22, 1896, from accidental injuries received while in the discharge of his duties at the college farm.

TEXAS STATION.—J. W. Carson, assistant director and foreman of the farm, has resigned, to take effect January 1, 1897.

ONTARIO AGRICULTURAL AND EXPERIMENTAL UNION.—The Eighteenth Annual Meeting of this association was held at the Ontario Agricultural College, Guelph, December 10 and 11. Many interesting papers were presented.

PERSONAL MENTION.—Prof. W. Fleischman, of Königsberg, the eminent authority on dairying, has been appointed director of the Agricultural Institute at Göttingen, in place of Professor Liebscher, who died the past summer. The vacancies caused by his transfer have been filled by the appointment of Prof. A. Backhaus, formerly of Göttingen, as professor in the University and director of the Agricultural Institute; and Professor Kreiss as director of the Experiment Station and School for Dairying at Kleinhof-Tapiau.

Hugo de Vries has been appointed director of the Botanic Garden in Amsterdam, succeeding Dr. Oudemans.

Dr. W. Rothert has been chosen extraordinary professor of botany in the University of Kazan.

Mr. L. P. Smith, formerly professor of agriculture at the Iowa Agricultural College, who for over a year and a half has been connected with this Office, died suddenly at his home December 2, 1896.

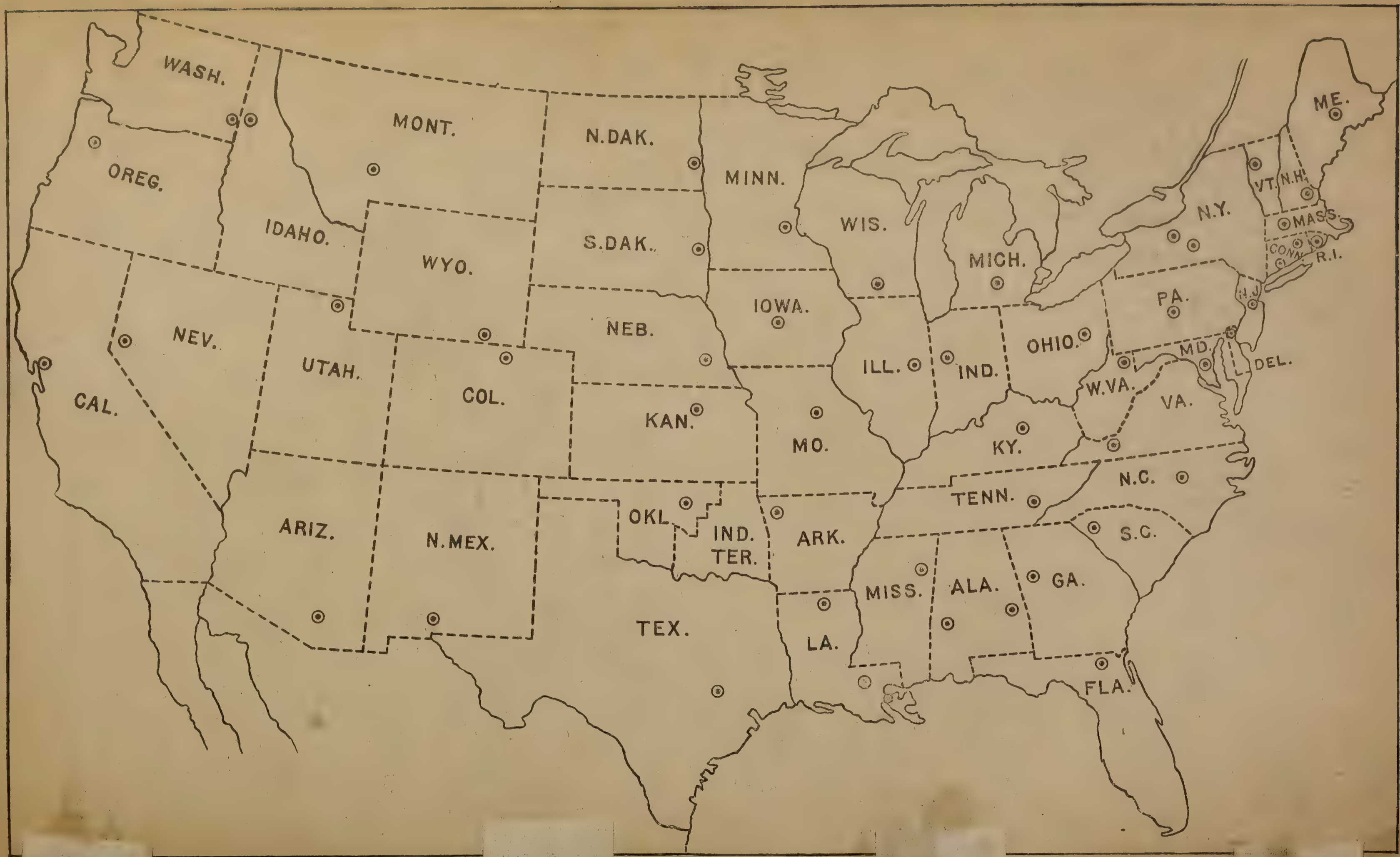
PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1-11; Vol. VIII, Nos. 1-4.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894; No. 20, Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Chicago, Illinois, October, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895; No. 24, Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., November 13-15, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Denver, Colorado, July 16-18, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University, Lafayette, Indiana, in 1895; No. 33, The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates.



THE AG... ...PERIMENT STATIONS OF THE UN...

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII No. 6

EXPERIMENT STATION RECORD

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1897

U. S. DEPARTMENT OF AGRICULTURE.

Scientific Bureaus and Divisions.

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¶ Acting director.

EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
WALTER H. EVANS, PH. D.—Botany and Diseases of Plants.
——— ———-Horticulture, Entomology, and Veterinary Science.
F. H. HALL—Field Crops.
C. F. LANGWORTHY, PH. D.—Foods and Animal Production.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

CONTENTS of Vol. VIII, No. 6.

DAIRY FARMING AND DAIRYING.

STATISTICS.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

Vol. VIII. No. 6.

Much serious thought and effort are at present being devoted to the construction of a true science of agriculture. The application of scientific methods and principles to the promotion of the art of agriculture is more and more sought after. Teachers of agriculture are becoming thoroughly alive to the importance, if not the necessity, of reducing their instruction to systematic form if agricultural courses are to maintain their proper standing. At this juncture both investigators and teachers in agricultural lines can without doubt learn much from what is taking place in the evolution of other sciences, and especially of the sciences which, like agriculture, deal with complex materials and whose ultimate aims are practical. Such a science is economics, and the recent perusal of a treatise on that subject has brought to our attention a passage which we deem well worthy of consideration by students of agricultural science. We quote the following paragraphs from Principles of Economics, by Prof. Alfred Marshall, of Cambridge University: "Though we are bound, before entering on any study, to consider carefully what are its uses, we should not plan out our work with direct reference to them. For by so doing we are tempted to break off each line of thought as soon as it ceases to have an immediate bearing on that particular aim which we have in view at the time; the direct pursuit of practical aims leads us to group together bits of all sorts of knowledge, which have no connection with one another except for the immediate purposes of the moment, and which throw but little light on one another. Our mental energy is spent in going from one to another; nothing is thoroughly thought out; no real progress is made. The best grouping, therefore, for the purposes of science is that which collects together all those facts and reasonings which are similar to one another in nature, so that the study of each may throw light on its neighbor. By working thus for a long time at one set of considerations we get gradually nearer to those fundamental unities which are called nature's laws. We trace their action first singly and then in combination, and thus make progress slowly but surely. The practical uses of economic [agricultural] studies should never be out of the mind of the economist [agriculturist], but his special business is to study and interpret facts and to find out what are the effects of different courses acting singly and in combination."

The account of the last convention of the Association of German Experiment Stations, given in this number, is especially interesting from the fact that the meeting is described from an American standpoint. The previous accounts given from year to year have been prepared from summaries of the proceedings as published in current German periodicals. At the suggestion of this Office the convention last September was attended by Mr. Fassig, formerly of the Weather Bureau of this Department, who is studying abroad. His account brings out a number of interesting facts in regard to the organization and conduct of the association which have not hitherto been noted.

It will be seen that the association is by no means as broad in its scope or provisions for membership as our Association of American Agricultural Colleges and Experiment Stations, or even as our Association of Official Agricultural Chemists, which it most closely resembles.

It has far less points of interest common to its members because the German stations have a greater diversity in organization and general management than those in this country. Some are under the control of the State, others of the province, and others of the agricultural associations, and they are not alike responsible to any imperial or general Government. Consequently the field of operations of the association has been rather restricted, and has been quite largely confined to studies on methods for analysis and control of fertilizers, feeding stuffs, and seeds. In this the association is confronted by much the same questions and difficulties which our Association of Official Agricultural Chemists has to contend with, and it is studying these questions in much the same way.

This community of interest has led to the suggestion of coöperation between the associations in the two countries, which, although it has never been successfully inaugurated, would seem to be practicable and helpful.

The deliberations of the German association will always possess a special interest to the agricultural chemists of this country, and, in the nature of the case, the two associations will to a certain extent supplement each other in their work.

THE NINTH ANNUAL CONVENTION OF THE ASSOCIATION OF GERMAN AGRICULTURAL EXPERIMENT STATIONS, 1896.[1]

Oliver L. Fassig.

By a provision of the constitution of the Association of German Agricultural Experiment Stations its meetings are held in close connection with those of the Association of German Naturalists and Physicians (*Gesellschaft deutsche Naturforscher und Aerzte*), the association which in Germany corresponds to our American Association for the Advancement of Science. Whenever possible, a neighboring town is chosen in which there is an experiment station. This year as the naturalists and physicians met at Frankfort on the Main, the station meetings were held in Wiesbaden, distant about half an hour's ride from Frankfort. Wiesbaden is an attractive town of about 60,000 inhabitants situated in the midst of the vine-growing region of the Rhine, and is famous for its mineral springs. It is the home of Fresenius, so well known to all readers of chemical literature. In connection with the famous Fresenius laboratory is the Wiesbaden Agricultural Experiment Station with Prof. H. Fresenius, son of the above mentioned, as director.

The association is composed of agricultural experiment stations in the German Empire, each of which is entitled to send one voting delegate to the annual meetings. Membership is restricted to such stations as are under the control of the State, province, or an agricultural society, and conducted in the interests of the public. The association numbers about 50 stations. It does not include all the stations eligible to membership, as it is not a State institution and membership is not compulsory.

The method of organization and the nature of the work done are referred to with special emphasis here since these received a large share of attention at this meeting, as will appear later on. The work of the association is largely along chemical lines, corresponding in this respect to our Association of Official Agricultural Chemists. The main purpose, as expressed in the constitution, is to secure uniformity in methods of analysis and of control of fertilizers, feeding stuffs, and seeds.

The association is governed by an executive committee of 5, chosen for 3 years. The chairman of the executive committee presides at the annual meetings. This committee names the members of committees, to which are referred questions relating to methods of analysis. Of these there are apparently at present 4; (1) a committee for the investigation of fertilizers; (2) one for the investigation of feeding stuffs; (3) one for soil analysis; (4) one for seed examination. An important

[1] An account of the eighth annual convention, abstracted from the published proceedings, is given on p. 462.

section of the constitution is that which requires favorable action at two consecutive annual meetings before any proposed method of analysis becomes the officially recognized method of the association. In questions concerning technical analysis only such decisions as are unanimously supported by the delegates present are binding. In purely scientific questions no resolutions are binding.

The present meeting of the association, which was the ninth, was held September 18 and 19, 1896. The evening previous to the meeting the delegates, to the number of about 30, met informally in the dining room of one of the hotels, where, after being welcomed by the president, Professor Dr. Nobbe, director of the Experiment Station at Tharand, Saxony, they renewed acquaintance with one another for a few hours in the genial and social way characteristic of German meetings.

The following day the formal opening of the sessions took place at 9.30 a. m. in one of the halls of the "Kurhaus." There were about 40 persons present, about 30 of whom were voting delegates. The elder Fresenius was expected to lend his presence at the opening session, but he was out of the city and unable to return in time. After a few introductory remarks, the president gave a brief review of such of the year's happenings as were of interest to the members, and congratulated the association on having happily emerged from the "storm and stress" period of its history. The treasurer then presented his report on the financial transactions of the past year. Officers were elected and appointed to fill vacancies occurring during the year. Professor Emmerling, of Kiel, was elected a member of the executive committee; Professor Dietrich, of Marburg, was appointed on the committee on soil analysis, and Dr. Rodenwald, of Kiel, on the committee on seed examination.

Professor Maercker, of Halle, in behalf of the committee on fertilizers, reported the results of investigations authorized at the meeting held in Kiel the preceding year, which may be briefly summarized as follows:

(1) The results of coöperative determinations in 5 laboratories of potash in aqueous and hydrochloric acid solutions of carnallit, kainit, sylvinit, and a mixture of kainit and polyhalit, show close agreement, there being practically no difference between the amounts found in the water and acid solutions. The short method of Fresenius gave good results, provided the potassium-platinic chlorid was dissolved on the filter, evaporated to dryness, and weighed, or the impurities left on the filter were weighed and deducted. The results of tests by the Darmstadt station of alcohol of different strengths for washing the final precipitate are reported.

(2) Tests by the Möckern[1] and Hildesheim stations of the methods of determining ammoniacal nitrogen in fertilizers by distillation with magnesia and soda are reported, showing practically no difference in the results by the 2 methods.

[1] Chem. Ztg., 20 (1896), No. 17, p. 151 (E. S. R., 7, p. 826).

(3) The results of comparative tests by the Hildesheim and Brunswick stations and by Mach and Passon[1] of the citrate and molybdate methods of determining phosphoric acid in Thomas slag are tabulated without comment.

The next business in order was the second reading of certain resolutions passed by the association at the Kiel meeting. These resolutions were ratified and therefore become a part of the official methods of the association. They are as follows:

(1) The determination of citrate-soluble phosphoric acid in Thomas slag meal is to be made in exact accordance with the directions for the P. Wagner method, using a rotary apparatus.

(2) Phosphate slag meal should no longer be sold on the basis of its total phosphoric acid, but the effort should be in the future to have it sold entirely according to its content of citrate-soluble phosphoric acid, dropping the guaranty for fine meal.

(3) In determining the soluble potassium oxid 10 gm. of the substance which passes a 1 mm. sieve is heated for a quarter of an hour with 400 cc. of water, made to 500 cc. after cooling, and an aliquot taken for the determination.

(4) The ammoniacal nitrogen in commercial ammonia salts and in fertilizers containing the same is determined by distillation with magnesium oxid.

(5) Magnesia is to be added to the list of ingredients recognized as determining the value of limestone, and is accordingly to be taken account of in examination of such material.

(6) Concerning the determination of intrinsic worth of beet seed—

(*a*) The distinction between large and small seed bolls is discontinued.

(*b*) One gram of bolls must produce at least 50 plantlets.

(*c*) Out of every 100 seed bolls at least 75 must germinate in 14 days.

(*d*) The foreign matter shall not exceed 3 per cent or the water content 15 per cent; however, beet seed with as high as 17 per cent of water may be furnished subject to a corresponding indemnity.

(7) In the case of feeding stuffs in which the carbohydrates are taken into account, the money value or the indemnity is determined on the basis of the proportion of 3 : 3 : 1, for 1 kg. of protein : fat : carbohydrates.

It was also voted to exclude from the deliberations of the association the Union of Fertilizer Manufacturers, which was admitted at the meeting at Würzburg in 1894.

Dr. Kellner and Dr. Loges were appointed to carry out the resolutions of the Kiel meeting in reference to the furnishing of reliable and pure reagents by the chemical factories.

Upon motion of Professor Maercker it was voted to amend the section of the constitution relating to the adoption of analytical methods. There was some difference of opinion among members as to whether methods agreed upon should go into effect after the first reading or not

[1] Ztschr. angew. Chem., 1896, Nos. 5, p. 129; 10, p. 286 (E. S. R., 8, p. 23).

until after the second reading. The decision arrived at was that these methods should go into effect immediately after the first favorable action, provided the committee charged with testing the methods makes known the results to all members of the association at least 2 months before the meeting at which the method is to be first voted upon. By this means all will have an opportunity to test the method thoroughly during the first year, and the association will be in position to take intelligent action at the second and final reading.

Professor Pfeiffer presented a paper upon the determination of phosphoric acid in precipitates,[1] previously published.[2] It has been assumed that the phosphoric acid in precipitated phosphates was in the form of dicalcic phosphate (reverted). The author found that aside from dicalcic phosphate the precipitates apparently contained considerable amounts of pyrophosphates, and that solution in concentrated hydrochloric acid did not give all of the phosphoric acid in the material. It was found necessary to use nitric acid in addition to hydrochloric acid in order to completely convert the pyrophosphoric acid into a form which magnesia mixture will precipitate.

A general discussion of the paper followed, at the close of which Professor Pfeiffer offered the following resolution, which was subsequently adopted at the first reading:

(1) It is to be desired that in the sale of precipitated phosphates a guaranty be given for the phosphoric acid present in the form of dicalcium phosphate (citrate-soluble).

(2) The committee on fertilizers is directed to test the methods for the determination of citrate-soluble phosphoric acid (dicalcium phosphate) in precipitated phosphates.

Professor Pfeiffer was followed by Professor Emmerling, of Kiel, with a paper on the sand content of certain commercial feeding stuffs. He presented a table showing the sand content of peanut meal, peanut cake, cocoanut cake, palm-nut cake, palm-nut meal, linseed cake, rape cake, rice feed, and rye bran as determined by a number of stations. He suggested a classification for feeding stuffs, according to their sand content, into good, medium, and bad, attempting to fix the limits to the sand content for each of these classes. For example, for peanut meal 1 per cent or less of sand would be considered as "good," from 1 to 2 per cent as "medium," and over 2 per cent as "bad."

After considerable discussion it was decided to postpone definite action with reference to this classification until the next meeting.

At about 3 p. m. the association adjourned for the day. After partaking of a dinner prepared for them, some of the members visited the Fresenius laboratory and the local experiment station, while others returned to the "Kurhaus" park where a special program of music,

[1] This product, precipitated phosphates, is not found on the market in this country to any extent.

[2] Landw. Vers. Stat., 47 (1896), No. 4–5, pp. 357–360.

illumination, and fireworks was in store for them. With the brilliant illumination, the play of fountains and the music, the gardens presented a veritable fairyland scene.

At 9 a. m. of the following morning a meeting of the executive committee was held. The public session began about 10 o'clock. The venerable Fresenius occupied a place by the side of the president and remained during the morning session. Dr. Müller, of Hildesheim, presented a report upon further investigations in the determination of fat in molasses feed. He was followed by Professor Emmerling, of Kiel, with a committee report upon the presence of free and volatile fatty acids in feeding stuffs. Two other papers were read before the close of the morning session, one a committee report by Professor Maercker on an examination of the Glaser-Crispo method for the determination of sesquioxids in phosphates, and the other a paper not on the program by Dr. Sjollema, of Groningen, Holland, on the occurrence of perchlorates in Chili saltpeter, and the injurious effects of this upon rye.

The afternoon session, which lasted about an hour and a half, was devoted almost exclusively to the consideration of a pamphlet published recently by Prof. Adolf Mayer, of Wageningen, Holland, upon experiment stations as State institutions.[1] As this pamphlet excited a lively discussion and a display of considerable feeling on the part of the association, and also as it is an effort to bring about closer international relations between directors of agricultural experiment stations, a somewhat full account of its contents and of its reception by the German association is here given.

Professor Mayer is director of the experiment station at Wageningen, and chairman of the college of directors of experiment stations of Holland. The purpose of the pamphlet, as expressed by the author, is to inaugurate an effort to bring about a more systematic and thorough national organization by means of State control, with the ultimate result of establishing closer international relations. The personnel of the stations is first considered. A special preparation for the work is deemed necessary; a general university course is not sufficient. Practice in analytical methods in agricultural chemistry and botany is considered a necessary requirement, and the establishment of a State examination for station workers is advocated. The author would have a station force consist of (1) a director responsible for all the work of the station; (2) a larger or smaller force of scientific assistants with the title of chemist, botanist, etc.; (3) aids, laborers, etc. This seems to be directed against the German organization, where in general all below the director are classed as assistants, without reference to the character of the work or position.

The second chapter contains a brief history of the origin and growth of the experiment stations in different countries; a discussion of the

[1]Die landwirthschaftliche Versuchsstationen als Staats-Institut. Beiträge zu der Reform dieser Anstalten, von Dr. Adolf Mayer. Heidelberg: Carl Winter's, Universitätsbuchhandlung, 1896, pp. 84.

best methods of management; a consideration of the extent to which the State ought to have control, and to what extent the control may be left with advantage to agricultural and other associations; the advantages of a national organization, with examples of the unsatisfactory character of private control; closing with a report of the Holland commission for the establishment of stations under State control.

In the next chapter the author describes in detail what a national organization should be in order to secure prompt and reliable analyses for purposes of control. He compares the national organization and methods of analysis of Holland with those of Germany to the great advantage of the former.

In the fourth and last chapter the international relations of stations are considered, and the best methods of accomplishing international coöperation. The author points out what he considers defects in the existing organization of certain systems, particularly those of England and Germany, which, in his opinion, stand in the way of any successful effort to establish international coöperation and thus further increase the usefulness of these institutions. An international organization is not practicable, the author thinks, until in all those countries which it is desired to include there is a central and official supervisory head.

The author further points out what he considers serious faults in the organization of the German association, namely:

(1) The association is composed of stations which are dissimilar in many respects. Some are under the control of the State, others of the province, and others of agricultural societies; and some can act independently while others can not vote upon certain important questions without instruction from their control. (2) In technical analytical questions, only those resolutions which are passed by the unanimous vote of those delegates present are binding; *i. e.*, a single dissenting vote can defeat the majority. This puts too much power into the hands of a few. (3) The stations are not required to join the association, and some stations are debarred from entrance. This results in a great diversity in the competence and reliability of stations with consequent evil results for the agricultural public.

The author expresses the hope that his views may be discussed and combated, as "Des chocs des opinions résulte la vérité." This wish is being gratified in Germany probably beyond the hopes of the author. The association took official notice of the pamphlet and its charges by arranging for a discussion of it at the Wiesbaden meeting. The discussion was opened by Prof. H. Schulze, of Brunswick, with a vigorous and scathing reply to the charges of Professor Mayer, which called forth a lively debate. The opinion seemed to be unanimous that Professor Mayer's criticisms of the association were unjust and uncalled for. They were the result of an inexcusable misunderstanding of the German organization and of the difficulty of securing a central organization, even if desired, in a country with such diverse interests as those

of the German Empire, and of such a complex political character. Opinions differed as to the propriety of taking further official notice of the pamphlet, some believing it would be better to leave the defense to individual members. The matter was finally settled by passing a resolution rebuking Professor Mayer for what was considered an unjust attack upon the association.

The following resolutions received their first reading and favorable action, and will be brought before the association again at its next annual meeting:

(1) Only water shall be used in making the solution in analysis of Stassfurt potash salts. The short method (Fresenius) for potash determination is accepted as the association method, although the potassium-platinic chlorid precipitate should be purified by dissolving, etc.

(2) In superphosphate the citrate-soluble phosphoric acid as determined by Petermann's method is to be separately determined when requested instead of designating the sum of that soluble in water and in the citrate solution as "citrate-soluble" phosphoric acid.

(3) The ammoniacal nitrogen in ammonia salts and mixtures of the same with superphosphates or other materials is to be determined by heating 1 gm. of substance with 3 gm. of magnesium oxid as nearly free from carbon dioxid as possible. The question whether the substance itself or a solution of the substance is to be used for this determination is to be further investigated by the committee on fertilizers.

(4) The designation "Ammonia-nitrogen superphosphate (Am. st. Sup.)" customarily used by the German Agricultural Society for fertilizers composed of mixtures of ammonia salts, materials containing organic nitrogen, and superphosphates is undesirable and leads to confusion. Accordingly a new designation is to be fixed upon.

(5) The committee on fertilizers is instructed to make comparative studies of the determination of sesquioxids by the methods of Crispo, Glaser, and von Grüber.

This concluded the business of the general sessions and there remained only some social features—a dinner at the "Kurhaus," and later in the evening a final and informal gathering at the hotel, similar to that of the first evening.

For the following day (Sunday) short excursions to interesting points along the Rhine had been planned, but the rain interfered with these arrangements.

The next annual meeting of the association will be held at Brunswick in September, 1897.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The behavior of paracasein toward rennet, O. HAMMARSTEN (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 103–126*).—In 1894 R. Peters[1] published investigations including among other things a study of the action of rennet on the proteids of milk. He concluded from these studies that when the paracasein resulting from the action of rennet on casein was dissolved in the smallest possible amount of lime water it could be reprecipitated by rennet, and that this dissolving in lime water and curdling with rennet could be repeated many times. This was contrary to the previous work of the author, who further investigated Peters' conclusions. It was found that the rennet extract used by Peters contained considerable common salt, whereas the author had used rennet free from salt; and the author's experiments showed conclusively that salt was capable in a marked degree of curdling solutions of paracasein, both in presence and in absence of soluble lime salts. Rennet free from salt invariably failed to curdle lime water solutions of paracasein, but the extract used by Peters always curdled the solutions, even though the extract was heated to destroy the ferment. Hence it was clear that the curdling action observed by Peters was due entirely to the salt in the rennet extract which he used rather than to the rennet itself.

Paracasein prepared under varying conditions was found to have somewhat different properties, but all preparations of it agreed in not being capable of reprecipitation with rennet enzym. This property the author regards as the most pronounced difference between casein and paracasein.

Solutions of casein in lime water which failed to curdle with rennet on account of a deficiency of soluble lime, gave a voluminous precipitate of paracasein when the proper amount of lime-free common salt was added. This action of salt is confined within rather close limits, and depends upon the concentration of the casein solution, and also the temperature.

On the peculiar relations of solubility of barium sulphate, R. FRESENIUS and E. HINTZ (*Ztschr. analyt. Chem., 35 (1896), No. 2, pp. 170–183*).—From 6 series of experiments the authors found that—

(1) (*a*) One part barium sulphate remains in solution after 24 hours' standing in 100,000 parts of pure water. (*b*) Barium chlorid or free sulphuric acid decreases considerably the solubility of barium sulphate

[1] Untersuchungen über das Lab und die labähnlichen Fermente. Rostock, 1894.

in water, the latter being more effective than the former. In the presence of one of these 1 part of barium sulphate is soluble in about 400,000 parts of water.

(2) (*a*) Fifty mg. barium sulphate remains permanently dissolved in 500 cc. of an 8 per cent solution of ammonium chlorid, corresponding to 1 part of the barium salt to 10,000 parts of the solution. (*b*) Barium chlorid or free sulphuric acid reduces the solubility of the barium salt in ammonium chlorid solution, its solubility in 10 per cent ammonium chlorid solution with moderate excess of sulphuric acid being 1 part in 400,000 parts (same as in water), while in presence of barium chlorid the solubility is 1 part in 50,000 parts of solution. (*c*) From (*a*) and (*b*) the conclusion is drawn that while ammonium chlorid in large amounts does not hinder the precipitation of barium by sulphuric acid, which is always added in excess, it does interfere with the complete precipitation of sulphuric acid by barium chlorid.

(3) (*a*) While barium sulphate dissolves in dilute solutions of ammonium chlorid to a far greater extent than in pure water, it is less soluble in them than in more concentrated solutions. (*b*) In the presence of moderate quantities of ammonium chlorid (2.5 parts in 100 cc. of liquid) the precipitation of barium by sulphuric acid is practically complete, while the precipitation of sulphuric acid by barium chlorid is sufficiently complete for quantitative purposes.

(4) (*a*) In a 2.3 per cent solution of sodium chlorid 20 mg. of barium sulphate remained dissolved in 440 cc. of the solution, corresponding to 1 part in 22,000, which is practically the same result as obtained with ammonium chlorid, though the latter is remarked to have somewhat more solvent power than the former. (*b*) The solubility of barium sulphate in stronger sodium chlorid solutions corresponds with its solubility in ammonium chlorid solutions of like strength; and barium chlorid or sulphuric acid acts in the same way in reducing its solubility as they do in ammonium chlorid solution. (*c*) The presence of barium sulphate in mineral waters containing chlorids is explained on the basis of the above facts.

(5) (*a*) About 1 part of barium sulphate is dissolved by 7,300 parts of nitric acid (7 to 8 per cent). (*b*) Barium chlorid and free sulphuric acid reduce very materially the solubility of barium sulphate in dilute nitric acid, sulphuric acid reducing the solubility to 1 part in 400,000, while 30 cc. of barium chlorid reduces the solubility from 3 mg. in 100 cc. to 1 part in 33,000. (*c*) From (*a*) and (*b*) the authors conclude that barium and sulphuric acid can be estimated with sufficient accuracy for analytical purposes in nitric acid solutions of 10 per cent or less by the addition of an excess of sulphuric acid or of barium chlorid, as the case may be.

(6) (*a*) The solubility of barium sulphate in 7 to 8 and 10 per cent hydrochloric acid is practically the same as in nitric acid of the same

strength, though sulphuric acid and barium chlorid reduce the solubility in hydrochloric acid somewhat more than in nitric acid. (*b*) Barium can be almost completely precipitated from either 10 per cent hydrochloric or nitric acid solutions by an excess of sulphuric acid; but in precipitating sulphuric acid by barium chlorid in a 10 per cent hydrochloric acid solution 1 mg. of barium sulphate remains in each 100 cc. of the filtrate.—B. W. KILGORE.

The hydrolysis of raffinose by soluble ferments, E. BOURQUELOT (*Jour. Pharm. et Chim., ser. 6, 3* (*1896*), *p. 390; abs. in Chem. Ztg., 20* (*1896*), *No. 36, Repert., p. 139*).—The author investigated the action of the invertin of *Aspergillus niger* on pure raffinose. One gram of crystallized raffinose (0.848 gm. anhydrous raffinose) yielded 0.690 gm. of sugar expressed as dextrose. The rotation decreased from (α) D=103.12° to about 50°. According to Scheibler the total hydrolysis of raffinose consists of 2 stages expressed by the reactions:

$$(1)\ C_{18}H_{32}O_{16}+H_2O=C_6H_{12}O_6+C_{12}H_{22}O_{11};$$

$$(2)\ C_{12}H_{22}O_{11}+H_2O=C_6H_{12}O_6+C_6H_{12}O_6.$$

The first reaction would express a final rotation of about 52 to 53°. The hydrolysis had therefore entered the second stage in the author's experiments. Comparisons were also made with the soluble ferment obtained from 2 trade yeasts. Bakers' yeast gave about the same results as Aspergillus, while with a brewers' yeast the hydrolysis continued even further, the final rotation being about 45° and sugar corresponding to 0.79 gm. being found.—W. H. KRUG.

Comparisons of methods of determining citrate-soluble phosphoric acid in Thomas slag, M. PASSON (*Ztschr. angew. Chem., 1896, No 10, pp. 286–288*).—The following 3 methods were compared on the citrate solution of 50 samples of Thomas slag obtained by the Wagner method:

(1) Fifty cc. of the citrate solution was heated with 100 cc. of Wagner's molybdic solution for 15 minutes in a water bath at 80 to 85° C., stirring 3 times and not allowing the beaker to touch the bottom of the bath. The solution was cooled 1½ to 2 hours, filtered, the precipitate washed 3 times with 1 per cent nitric acid, dissolved in 2 per cent ammonia, the filter being washed until the filtrate amounted to about 100 cc. (about 10 times); 15 cc. of magnesia mixture was then added drop by drop, with stirring, and the solution allowed to stand 2 hours, and filtered. The precipitate was washed 10 times with 5 per cent ammonia, burned and ignited 5 minutes, and weighed.

(2) The Müller modification of the above in which the yellow precipitate was washed by decantation with 1 per cent HNO_3, dissolved in 2 per cent ammonia, the filter washed out 7 times, 50 cc. of ordinary citrate solution and 25 cc. of magnesia mixture added, stirred for 10 minutes, and filtered through a Gooch crucible.

(3) The oxidation method of Mach and Passon.[1]

It appears that as a rule the first gives the highest results, the other two following in order.

An important source of error is claimed to be the precipitation of silicic acid if the temperature is allowed to rise above 80 to 85° C.

On the quantitative determination of potash, J. H. VOGEL and H. HAEFCKE (*Landw. Vers. Stat., 47 (1896), No. 2–3, pp. 97–143, figs. 6*).—The various methods which have been proposed for the determination of potash are reviewed and their faults pointed out, especial attention being given to (1) the Fresenius short method[2] and (2) the Lindo-Gladding method as adopted by the Association of Official Agricultural Chemists. In the first the sulphuric acid is precipitated in acid solution, carefully avoiding an excess of barium; and the double salts of sodium, calcium, and magnesium are washed out of the final precepitate by means of alcohol. The author's experiments indicate that this can be effectually done, but that if more than 75 cc. of alcohol is used a certain amount of the potassium-platinum salt is also dissolved. The averages of 4 tests of the solubility of this salt are: 1 : 35,196 for absolute alcohol, 1 : 31,523 for 95 per cent alcohol, and 1 : 20,760 for 80 per cent alcohol. It is further urged against this method that the weighing on the filter or after dissolving on the filter, evaporating, and drying in a weighed dish is inaccurate. In the latter case the water is not completely expelled from the large crystals of the double salt, and an error is thus introduced which varies with the size of the crystals. There is also danger of error from an excess of barium. The double salt of barium is said to be decomposed by alcohol, and barium chlorid is formed which is insoluble in that medium.

By extraction of 5 gm. of the barium sulphate precipitate with hydrochloric acid there was found from 0.09 to 0.15 per cent of potassium chlorid which had been occluded.

The Lindo-Gladding method is condemned on the following grounds: (1) The addition of sodium chlorid increases the amount of washing necessary and the chances of error from solution of the potassium-platinum chlorid in the ammonium chlorid solution. (2) The precipitate not being ground, the thoroughness of washing varies with the size of the crystals. Such being the case, it follows that (3) it is inaccurate to weigh the double salt directly, but it should be reduced and the washed and dried platinum weighed.[3]

The method proposed by the authors is as follows: In case of potash salts dissolve 10 gm. in 300 cc. of hot water, make up to 500 cc., evaporate 50 cc. of the solution to dryness, add 20 cc. of neutral

[1] Ztschr. angew. Chem., 1896, No. 5, p. 129 (E. S. R., 8, p. 23).

[2] Quantitative Analyses, 6th ed., vol. 2, p. 292.

[3] It will be seen that these objections are based principally on a feature of the original Lindo-Gladding method, viz, the addition of NaCl, which has long since been abandoned by the Association of Official Agricultural Chemists. The method described is that adopted by the Association in 1887.

carbonate of ammonia[1] to remove the lime and magnesia, and allow to stand 12 hours. Filter and wash with 10 to 15 cc. of the precipitant and evaporate to dryness in a platinum dish with the addition of a very little concentrated sulphuric acid, keeping the dish carefully covered during the early stages of the evaporation. Drive off the ammonia salts at a red heat, take up in hot water, filter into a porcelain dish, add the necessary amount of platinum chlorid[2] and a drop of dilute hydrochloric acid, and evaporate on a boiling water bath to a sirupy consistency. Cool, add 20 to 25 cc. of a mixture of alcohol and ether (2 to 1), grind up the crystals and allow to stand 15 minutes, and filter through a porcelain crucible with perforated bottom. Pass a stream of purified hydrogen over the double salt in the crucible, at the same time heating gently, until the salt is reduced (with the device described this usually requires 10 to 15 minutes). Cool, wash out the sodium sulphate and potassium chlorid produced with hot water, dry, ignite, and weigh the metallic platinum.

The solution of organic materials is prepared by digesting according to the Kjeldahl method, using 100 gm. of material, 100 to 125 cc. of acid, and 6 to 7 gm. of mercury, in case of barnyard manure, making up the final solution to 1 liter and using 50 cc. for the determination of potash. Neutralize this with ammonia, add 25 cc. of neutral ammonium carbonate, let stand over night, and make up to 200 cc. Evaporate 100 cc. of this solution to dryness and drive off the ammonium compounds. The latter can be safely and completely done by heating for 3 to 4 hours over a small flame. The rest of the operation is conducted as described above.

In case of poudrette, feeding stuffs, etc., 20 gm. is used, and of milk 100 cc. Tests of the method on a variety of substances gave very satisfactory results.

A method for working up platinum refuse into platinum chlorid is described in detail.

The determination of phosphoric acid in medicinal wines, F. GLASER and K. MÜHLE (*Chem. Ztg., 20* (*1896*), *No. 75, p. 723*).—The method proposed is as follows: Evaporate 100 cc. of wine in a 250 cc. digestion flask to a sirupy consistency, cool, add 25 cc. concentrated nitric acid, and warm gently until the reaction begins. This will go on without further heating. When the evolution of gas has ceased add 75 cc. of concentrated nitric acid and again warm gently. Evaporate nearly to dryness over a small flame, cool, add 10 cc. concentrated sulphuric acid, and a drop of mercury, and heat until the solution is light colored. Cool, fill the flask to the mark, and filter off 100 cc. of the solution, and determine the phosphoric acid in it.

It is stated that only the Fresenius method in which the residue from evaporation is carefully incinerated gives absolutely accurate results,

[1] A process for preparing this reagent according to Finkener is described.

[2] That used is H_2PtCl_6 and not $PtCl_4$.

but the above method has the advantage of being quicker, and the results obtained with it compare very favorably with those obtained by the Fresenius method.

Addition of formol to milk and a rapid method of detecting it, G. DENIGÈS (*Jour. Pharm. et Chim., ser. 6, 4 (1896), p. 193; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 244*).—The method is as follows: Ten to 12 cc. of milk is mixed with 1 cc. of fuchsin decolorized with sulphurous acid, and after standing 5 or 6 minutes about 2 cc. of pure hydrochloric acid is added and shaken. If the milk is free from formol the mixture will be yellowish white, even though it may have been reddish before adding the hydrochloric acid. If formol is present the mixture will be a "blue-violet" color, the intensity varying with the amount of formol. The reaction is said to enable the detection of 0.02 to 0.03 gm. of water-free formol per liter of milk, which is sufficiently delicate.

Butter examination, C. ASCHMAN (*Chem. Ztg., 20 (1896), No. 75, pp. 723, 724*).—The author describes the following method for distinguishing butter from oleomargarin: Five grams of butter fat is saponified with alcohol potash solution in the usual manner, the soap dissolved in water, 4 cc. of dilute sulphuric acid (50 gm. in 150 gm. water) added, made to 200 cc., 60 cc. of ether added, and the whole shaken at intervals for 5 minutes, after which the ether layer containing the volatile fatty acids quickly separates out. Twenty cubic centimeters of this ether layer is thoroughly shaken in a tube with 30 cc. of salt solution of 1.175 sp. gr. (300 gm. in 1 liter of water) and 8 cc. decinormal potash solution. After 1 or 2 hours a precipitate settles out, the volume of which is said to materially increase if oleomargarin is present. With pure butter this is said to be from 20 to 25 mm. in thickness, and in some cases more. The author is endeavoring to adapt the method to quantitative work.

The estimation of diastatic power in malt, W. G. SYKES and C. A. MITCHELL (*Analyst, 21 (1896), May, p. 122*).—The method proposed is a combination of those of Kjeldahl and Lintner and gives a diastatic value in one operation. Into a wide-mouthed 200 cc. flask are placed 100 cc. of a 2 per cent soluble starch solution and 1 cc. of the filtered extract prepared by digesting 25 gm. of ground malt with 500 cc. of water for 6 hours at the ordinary temperature. The whole is shaken and allowed to stand at 70° F. for 1 hour; 50 cc. Fehling solution is added, the flask covered with a watch glass and heated to 98° C. It is then immersed in boiling water for 7 minutes. The cuprous oxid is collected in a Soxhlet tube, reduced in hydrogen, and weighed. The weight found, divided by 0.438 (Cu. contained in 50 cc. Fehling) and multiplied by 100 gives the diastatic power.—W. H. KRUG.

A method for the determination of the diastatic power of malt, A. R. LING (*Jour. Fed. Inst. Brewing, 2 (1896), p. 335; abs. in Jour. Soc. Chem. Ind., 15 (1896), No. 8, p. 621*).—A determination is first made

by the Lintner method and those tubes selected in which reduction is almost complete, the contents transferred to a flask, boiled, and the unreduced Fehling solution titrated with a known glucose solution, containing conveniently 2 gm. per litre, potassium ferrocyanid being used as an indicator. The diastatic power is calculated by the formula $D\,P = \frac{10\ (5-y)}{5\ x}$ in which x represents the volume in cubic centimeters of normal extract taken and y the volume in cubic centimeters of unreduced Fehling solution found.—W. H. KRUG.

The estimation of the ready formed sugars of malt, G. H. MORRIS (*Jour. Fed. Inst. Brewing, 2 (1896), p. 224*).—The author desired to find a method by which the ready formed sugars in the malt could be easily and directly determined for commercial purposes. He first ascertained the time required to extract the whole of the ready formed sugars without the products of diastatic action. Ground malt was digested with water, portions withdrawn at stated intervals, and the specific gravity taken after filtration. This showed the maximum extraction to be completed in 2 hours, nothing entering into solution during the third hour. At the end of this time there is a considerable increase, due to the diastatic action. This shows that, to obtain concordant results, it is necessary to extract at a definite temperature for a constant time.

An attempt was made to estimate the ready formed sugars. The sugars of the aqueous extract were compared with the total sugars extracted by alcohol. The ready formed sugars in the cold water mash were estimated by difference and fermentation and the cane sugar was determined by inversion with yeast. A close agreement exists between the cane sugar in the alcoholic and aqueous extracts in the same malts. The ready formed sugars determined by fermentation are greater in the aqueous than in the alcoholic extract, and this is also the case with the total sugars estimated by inversion and cupric reduction. These results indicate that there are some other carbohydrates insoluble in alcohol but soluble in water which the author believes are formed simultaneously with the true sugars in the germinating grain. The author therefore uses the term "ready formed soluble carbohydrates" for the constituents of a cold aqueous extract of malt other than nitrogenous matter, ash, and acid. There is a fairly constant relation between the ready formed soluble carbohydrates determined by difference and the true sugars of a malt, which may be employed for calculating one into the other. Since no such relation appears to exist between the ready formed soluble carbohydrates and the sugars determined by fermentation, the latter method may also give inaccurate results.—W. H. KRUG.

The determination of dextrose, levulose, and saccharose as osazone, C. J. LINTNER and E. KRÖBER (*Ztschr. Brauwesen, 1896, p. 153; abs. in Ztschr. angew. Chem., 1896, No. 11, p. 336*).—The experiments were made with 1 to 2 cc. of a 10 per cent dextrose solution, 19 or 18 cc. of water, 1 gm. phenylhydrazin, and 1 to 1.5 gm. of 50 per

cent acetic acid. This was heated from 1 to 2 hours at 100° in the water bath, 20 cc. of boiling water added, the osazone collected on a tared filter which had been previously moistened with boiling water, washed with 60 to 100 cc. of boiling water, and dried at 105 to 110° for 3 hours.

The experiments with sucrose showed that the acetic acid failed to cause complete inversion, and in the subsequent experiments the sucrose was therefore inverted with hydrochloric acid, the acid neutralized with sodium acetate, the solution made up to 20 cc. and treated as before. In the presence of maltose the solution was heated 1.5 hours. This sugar increases the yield of dextrosazone slightly. When dextrin (achroo dextrin) is present 1.5 hours are insufficient to obtain the maximum yield of dextrosazone, and the solution must be heated 2 hours. Dextrin also increases the amount of osazone obtained.

The results are important, as they point a method of determining dextrose in the presence of maltose, isomaltose, and dextrins. The solution should not contain more than 0.2 gm. dextrose in 20 cc. One gram each of phenylhydrazin and 50 per cent acetic acid must be added and the solution heated 1.5 hours, 2 hours when dextrins are present. The osazone is washed with 60 to 80 cc. water and dried on a tared filter for 3 hours. Factor: 1 osazone=1 dextrose, in the presence of maltose and dextrin 1 osazone=1.04 dextrose. The factor for levulose under similar conditions is 1:1.43. Sucrose must be previously inverted; factor: 1 sucrose=1.33 osazone.—W. H. KRUG.

On the determination and the changes of hop tannin, and on the action of the hop tannin during the preparation of wort, J. HERON (*Jour. Fed. Inst. Brewing (1896), p. 162; abs. in Wochenschr. Brauerei, 13, p. 497; and in Chem. Centbl., 1896, II, No. 3, p. 136*).—Ten grams of hops are placed in a flask marked at 1,005 cc. and shaken with 900 cc. of boiling water, digested on the water bath for 1 hour with occasional shaking, made up to the mark at 15.5°, well mixed and filtered as clear as possible; 100 cc. of the filtrate corresponds to 1 gm. of hops.

The following reagents are required for the determination: (1) Potassium permanganate solution containing 1 gm. per liter and standardized with deci-normal oxalic acid, 10 cc. of the latter requiring 31.6 cc. of the permanganate solution. (2) Indigo solution made by dissolving 5 gm. of the best indigo-carmine in 500 cc. of water, adding 50 cc. concentrated sulphuric acid, and diluting to 1 liter; 20 cc. of this solution should require 20 cc. of the above permanganate solution. (3) Gelatin solution; 25 gm. of Nelson gelatin are softened in 250 cc. of water for 6 hours, brought into solution by heating on the water bath, saturated with salt, made to a liter with saturated salt solution, well shaken, and filtered after standing for several days. (4) Dilute sulphuric acid, containing 50 cc. concentrated acid per liter.

The titration is made with 50 cc. of the hop extract in a flat, 1-liter, porcelain casserole, 20 cc. indigo solution and 100 cc. water being added. The permanganate solution is run in rapidly from a burette, the liquid being constantly stirred. The end of the reaction is shown by the color of the liquid changing from yellowish-green to golden yellow. From the number of cubic centimeters of permanganate used the amount absorbed by the indigo solution must be deducted, and the result multiplied by 2 gives the total oxidizable substance in 100 cc. of the extract.

One hundred cubic centimeters of the extract is now placed in a wide-necked flask, mixed with 100 cc. of the gelatin solution, well shaken, 50 cc. of dilute sulphuric acid added, together with a teaspoonful of kaolin, again thoroughly shaken, and filtered. One hundred cubic centimeters of the filtrate is placed in a porcelain casserole, 20 cc. of indigo solution and 500 cc. of water added, and the titration carried on as before. The amount corresponding to the indigo solution used is deducted, and the result multiplied by 2.5 gives the oxidizable substances not hop tannin present in 100 cc. of the extract.

To obtain comparable figures, the author expresses the amount of permanganate used in terms of oxalic acid. The gelatin solution must be tested with permanganate and the corresponding correction applied whenever found necessary.

Changes which the tannin undergoes during storage.—The author confirmed the well-known fact that the hop tannin decreases during storage. This seems to be especially so during the first year. No satisfactory method of preventing this is known at present, but the author found that sulphured hops kept much better than the unsulphured.

The influence of the hop tannin on the wort.—The author showed by experiments that the hop tannin does not precipitate a single soluble proteid during boiling, but that it seems rather to form a soluble compound with the peptones of the wort. He calls this soluble compound tannopeptone. As this compound is not changed by fermentation, it must be present in the finished beer, and the tannin in all normal hop beers is therefore not present in the uncombined state. It is therefore incorrect to assume the absence of tannin in a beer which, on the addition of oak tannin, gives a precipitate.—W. H. KRUG.

Eighth annual convention of the German Agricultural Experiment Stations (*Landw. Vers. Stat.*, *47* (*1896*), *No. 2–3*, *pp. 145–253*, *fig. 1*).—The eighth annual convention of this association was held at Kiel, September 12, 13, and 14, 1895, F. Nobbe presiding. Fifty-one members and visitors were in attendance. The following propositions approved by the previous convention were passed to the second reading and adopted: In the valuation of feeding stuffs protein, fat, and carbohydrates should stand in the ratio of 3:3:1; in control analyses phosphoric acid is to be determined by one of the old and well-tested

methods. The method proposed by F. Nobbe[1] for testing seeds of grasses and conifers was also adopted.

M. Maercker reported the results of coöperative tests undertaken with a view to determining the sources of error in the citrate method. The results of tests by 9 institutions on 5 different samples of Thomas slag of the Wagner and Naumann methods are reported. The latter method is described as follows: Digest 100 cc. of the filtered citrate solution obtained by the Wagner method in an Erlenmeyer flask with 30 cc. of concentrated nitric acid over the naked flame until the bulk is reduced to about 20 cc., add 25 cc. of concentrated sulphuric acid to separate the silica and boil for 10 minutes, wash into a 250 cc. flask, fill to the mark, filter, and use 100 cc. of the filtrate for the subsequent test by the citrate method.

The results reported show a better agreement than in previous years and indicate that the Wagner method gives reliable results when carefully carried out. It appears also that the allowable 0.75 per cent of variation agreed upon between the German Agricultural Society and the Association of Thomas Slag Manufacturers may be considerably reduced. While the Wagner method, using a rotary apparatus, gives reliable results on Thomas slag, it is not considered applicable to other forms of phosphate, such as steamed bone meal. The Naumann method apparently gave good results also.

At a meeting of the fertilizer section at Eisenach, April 15, 1896, it was decided that the citrate soluble phosphoric acid of superphosphates should be determined directly by the Petermann method and not by taking the sum of separate determinations of water-soluble and citrate-soluble phosphoric acid.

M. Maercker also presented a report on the advisability of requiring that Thomas slag be sold upon the guaranty of content of fine meal and citrate-soluble phosphoric acid. He reviewed investigations tending to show that the citrate solubility of the phosphoric acid is a measure of the fertilizing value of the phosphoric acid in the slag, and that the finer the slag the greater its solubility. The results of experiments were also reported, which indicated that not only the citrate solubility but the fertilizing value of slag for oats and alfalfa increased with the percentage of silicic acid which it contained.

C. Müller described a new form of rotary apparatus, which carries 8 digestion flasks and is driven by means of a weight and clock-work arrangement.

M. Maercker presented a report favoring the adoption of a uniform system of charges for determining citrate soluble phosphoric acid in Thomas slag; and a report on the determination of nitrogen in feeding stuffs by the Kjeldahl method, with special reference to the action of the last convention regarding the time of digestion of organic substances and the use of a mixture of phosphoric acid and sulphuric acid.

[1] Landw. Vers. Stat., 45 (1894), pp. 390, 391 (E. S. R., 7, p. 15).

The results were not very uniform, but the reporter recommended the following, which was adopted: In the examination of feeding stuffs by the Kjeldahl method sulphuric acid containing phosphoric acid is to be used, together with the addition of a sufficient amount of mercury. Digestion for more than 3 hours is unnecessary.

The proposed imperial control of the trade in feeding stuffs, fertilizers, and seeds was considered by the association. While the need of such control was conceded, attention was called to the fact that the position which the experiment stations have long occupied with respect to this work was not properly recognized in the proposed statute.

A report of comparative determinations of potash in a normal sample of kainit[1] at 31 laboratories was submitted by M. Maercker.

The difference between individual determinations is not so large as in previous years, the variation being from 12.72 to 13.61 per cent.

The long and short methods of Fresenius were compared and the following conclusions were reached:

(1) With the short method the use of 80 per cent alcohol appears to be indispensable, since stronger alcohol gives higher results.

(2) In many instances it was observed that the barium chlorid contained potash, and therefore a blank analysis is advisable.

(3) Hydrochloric acid solutions appeared to give higher results than water solutions. Further tests of this subject were advised.

(4) In the short method it is necessary to dissolve the precipitate in hot water and weigh the residue, since the potassio-platinic chlorid usually contains considerable amounts of impurities. For this purpose a Gooch crucible is especially convenient.

In order to get accurate results it is stated that only a very slight excess of barium chlorid should be used and the solution evaporated with platinum chlorid only to a sirupy consistency.

The section on fertilizers was instructed to study the question of the water solubility of potash in fertilizers in coöperation with the Kali Syndicate, and those members of the association, Halenke and Wagner, who have the greatest interest in the Albert salts were requested to investigate the nature of the potash and phosphoric-acid compounds in these preparations and to make vegetation experiments regarding their fertilizing value. In determining the soluble potash it is directed that 10 gm. of material which has passed a 1 mm. sieve shall be boiled for 15 minutes with 400 cc. of water. After cooling the solution is to be made to 500 cc. and an aliquot part used for the determination.

G. Loges submitted a report on the determination of ammoniacal nitrogen in ammoniated superphosphates. This is devoted principally to meeting the objections raised against the determination of ammonia by distillation with magnesium oxid. He shows first that the use of magnesium oxid gives as high results on both 1 gm. and one-half gm.

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[1] The discordant results reported at the previous meeting were attributed to the fact that an abnormal sample of potash salt was used for the tests.

samples as caustic soda, that the method adopted by the association gives practically the theoretical amounts of ammonia in materials containing from 9.5 to 16.8 per cent of soluble phosphoric acid, and that the amount of magnesium oxid recommended is fully sufficient to set free all the ammonia in pure ammonium salts. With triammonium phosphate and ammonium chlorid the two methods of distillation gave identical results. The presence of carbonate in the magnesia used was found to lower the percentage of ammonia. The method of distillation with the magnesia was not passed to its second reading at this meeting, because it had not been studied by the analytical committee of the German Fertilizer Manufacturers' Union. At a meeting of the section on fertilizers at Eisenach, April 15, 1896, it was decided to retain the method of determining ammonia by distillation with magnesia. In case of mixed fertilizers ammoniacal nitrogen is to be determined by distillation with magnesia of a solution obtained by shaking up 20 gm. of material with water for one-half hour.

An elaborate report on the fertilizing value of limestone containing magnesia was submitted by O. Kellner. He reported results of investigations that go to show that the magnesia of gray lime is as readily taken up by ordinary solvents as the lime, and that while the lime acts partly in the form of bicarbonate and partly in the form of quicklime the magnesia acts mainly in the form of soluble bicarbonate. It is stated further that soils that are deficient in lime and are benefited by its application are generally deficient in magnesia also, and that magnesia acts like lime in combining with humus substances, thus neutralizing the acid of the soil, promoting the decomposition of organic matter, and favoring nitrification. Like lime, it is also active in breaking down the silicates and setting free a certain amount of potash, in delaying the reversion of phosphoric acid in the soil, and in improving the texture of the soil. The poisonous effect of magnesia which has been frequently observed is claimed to be exerted only when the substance is used in large quantities unaccompanied by lime. The motion of Kellner that in determining the value of limestone magnesia must be taken into account was adopted.

Reports on the determination of fat and sugar in molasses fodder were submitted by C. Müller. After some discussion this subject was referred back to the section on feeding stuffs for further investigation.

A report on the determination of ergot in feeding stuffs was submitted by Ulbricht. He showed that the presence of *Polygonum convolvulus* in a feeding stuff destroys the reliability of the Hoffmann method and he describes a method of preparing samples for microscopical examination.

A report on the testing of feeding stuffs for sand was submitted by Emmerling. The section on feeding stuffs was instructed to collect the individual determinations which have heretofore been made of sand in feeding stuffs and to tabulate them on a uniform basis.

F. Nobbe reported on the valuation of sugar and fodder beet seed, and the following conclusions of the section on seed testing were adopted:

(1) The distinction between large and small seed bolls is given up.

(2) One gram of bolls must produce at least 50 plantlets.

(3) Seventy-five out of every 100 bolls must germinate in 14 days.

(4) Foreign constituents must not exceed 3 per cent and the water content 15 per cent, although beet seed containing as high as 17 per cent of water may be furnished subject to a corresponding indemnity.

A detailed description of methods for seed testing is given by F. Nobbe in an appendix to the report.

Concerning a new class of compounds of albuminoid bodies, F. BLUM (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 127–131*).

A contribution to the chemical and botanical study of gums, L. C. LUTZ (*Thesis, Paris: 1895; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 5, pp. 368, 369*).

The quantitative cleavage of albumen by hydrochloric acid, R. COHN (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 153–175*).—Discovery of a pyridin derivative.

The behavior of casein toward pepsin-hydrochloric acid, E. SALKOWSKI (*Arch. Physiol., 63 (1896), p. 401; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 245*).—A continuation of studies on the exact conditions under which casein is completely dissolved by pepsin-hydrochloric acid.

The determination of phosphorus in the ashes of coal and of coke, L. CAMPREDON (*Compt. Rend., 123 (1896), No. 23, pp. 1000–1003*).—It is shown that fusion with alkaline carbonates is the only reliable method of obtaining all the phosphoric acid in solution.

The quantitative determination of salicylic acid, F. FREYER (*Chem. Ztg., 20 (1896), No. 83, p. 820*).

The physical methods of butter examination, N. WENDER (*Ztschr. Nahr. Untersuch. und Hyg. Waar., 10, pp. 46–49; abs. in Chem. Centbl., 1896, I, No. 15, p. 830*).

Determination of the specific gravity of curdled milk, M. KUHN (*Chem. Ztg., 20 (1896), No. 73, pp. 708–710*).

Compendium for food chemists. Vol. 5: The chemistry and physiology of malt and beer, E. PRIOR (*Bibliothek für Nahrungsmittelchemiker. Bd. 5. Chemie und Physiologie des Malzes und Bieres. Leipzig: J. A. Barth*).

BOTANY.

The occurrence of arginin in the roots and tubers of some plants, E. SCHULZE (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 451–458*).—Arginin is a highly nitrogenous substance, $C_6H_{14}N_4O_2$, discovered by the author in the etiolated seedlings of lupine, and also found by G. S. Hedin[1] among the products of the cleavage of protein by acids. The author now finds this substance in the tubers of ruta-bagas and Jerusalem artichokes and the roots of *Ptelea trifoliata*. The examination was made in the spring, the roots having been kept in the ground over winter. Four kilograms of ruta-bagas, containing about 500 gm. of dry matter, yielded only 0.9 gm. of arginin, showing that the amount of this substance is small. It was accompanied by glutamin, asparagin, and tyrosin. In the Jerusalem artichoke and the roots of *Ptelea trifoliata*

[1] Ztschr. physiol. Chem., 20, p. 186.

the amount of arginin found was very small. The author believes it to be in the chicory root also, although he has not thoroughly identified it.

Effect of chemical agents on germination, W. SIGMUND (*Landw. Vers. Stat., 47 (1896), No. 1, pp. 1–58*).—The author reports on a series of experiments conducted to test the effect of certain chemical agents on the germination of wheat, rye, barley, peas, and rape seed. About 275 solutions of chemically pure agents were tested, the seed being soaked for 24 hours in 50 cc. of the solution, and then placed between filter papers to sprout. The maximum strength of solution used was 0.5 per cent. For each lot of seed tested a similar quantity was soaked for the same time in distilled water and germinated in the same manner.

The results of the experiments were tabulated, and the following conclusions drawn from them:

(1) Free mineral and organic acids were injurious to all the seeds, although the cereals were able to withstand dilute solutions, 0.1 per cent or less, of free acids. Salts having a strong acid reaction, are poisonous as compared with those having a neutral reaction.

(2) Free bases are poisonous, as are alkaline salts with strong basic reactions.

(3) The neutral reacting alkaline salts and alkaline earths were without injurious effect upon the cereals; in some cases the germination was accelerated up to the maximum concentration used, while peas and rape were able to withstand strengths of solution up to 0.3 per cent only. All the salts were injurious when used stronger than 0.5 per cent.

(4) Fat and ethereal oils hasten the germination of cereals, but retard that of peas and rape.

(5) The anæsthetics and carbon dioxid in gaseous form are very injurious. In liquid form they retard germination and check the growth of the plantlet. Peas have relatively a higher resistance to this influence than the other seed tested.

(6) Alkaloids and the physiologically similar artificial antipyretics, and soporifics weaken and retard germination when used in strengths of 0.1 per cent or more. Toward this class of agents wheat is less susceptible to injury than peas.

(7) Some of the organic antiseptics were injurious at 0.1 per cent, and all were when a greater strength was used.

(8) The anilin dyes were poisonous to seed when used in a concentration of 0.05 per cent.

(9) Plants are more resistant to the influence of organic than inorganic poisons.

Investigations on the effect of these agents upon the germinating plant, upon the soil, and upon the growing seed are to be continued.

Concerning the activity of fungus-diseased leaves, H. MÜLLER-THURGAU (*Jahresber. Vers. Sta. Wädensweil, vol. 4, pp. 54–58; abs. in Bot. Centbl., 68 (1896), No. 8, p. 266*).—The transpiration of the diseased

leaves was investigated by Stahl's cobalt chlorid test. It was found that pear leaves attacked by *Fusicladium pyrinum* and apple leaves attacked by *F. dendriticum* transpired from both surfaces of the diseased areas more than the normal amount, while pear leaves infected with *Sphærella sentina* were found to transpire no more from the diseased spots than from equal areas of the sound leaves.

Strawberry leaves attacked by *Sphærella fragariæ* were found to have their transpiration reduced.

Grape leaves, showing the presence of *Peronospora viticola*, gave no transpiration from the diseased areas, while the sound portions transpired as usual. The reason for the the checking of the transpiration is supposed to be due to the formation of conidia, the stomata being closed by the conidiophores.

The effect of fungi in leaves, upon their activity in starch and sugar formation, was investigated, and it was found that the young spots containing Fusicladium were free from starch, while the surrounding cells contained it in abundance. The cells in the Peronospora spots were without starch, as were the surrounding cells in the sound tissue, the area extending for several millimeters. The author ascribes this lack of food material to the action of the parasite, the starch, etc., having been withdrawn from the surrounding cells.

The adaptability of tubercle bacteria of unlike origin to different genera of Leguminosæ, F. NOBBE and L. HILTNER (*Landw. Vers. Stat., 47 (1896), No. 4–5, pp. 257–268, pls. 6*).—The experiments here reported were made in continuation of those given some 2 years ago,[1] and consisted in inoculating 10 genera representing 6 different tribes of leguminous plants with pure cultures of bacteria from the tubercles of *Phaseolus multiflorus*, *Pisum sativum*, *Trifolium pratense*, *Robinia pseudacacia*, and *Lupinus luteus*. The plants were grown in pots containing 1,200 gm. of air-dry garden soil, with a nitrogen content of 3.45 gm., and 6,800 gm. of pure quartz sand. Each pot was given as additional fertilizer 500 gm. potassium chlorid and 5,000 calcium phosphate. Records were compiled for each experiment and the results tabulated, showing the analyses of the plants grown with the different inoculations. It was shown that as a rule there could be no substitution of bacteria from one kind of legume for another except within narrow limits, the best results being secured when each plant had received an inoculation with its specific organism.

It was further shown by these experiments that:

"(1) The tubercles exert no influence upon the aërial parts of the plant so long as the supply in the soil furnishes nitrogen in sufficient quantity.

"(2) From the time when the nitrogen begins to fail, plants without tubercles or having poorly developed ones can not supply the required nitrogen, the leaves of legumes in no sense being organs for the assimilation of free atmospheric nitrogen."

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[1] Landw. Vers. Stat., 45 (1894), pp. 1–27 (E. S. R., 6, p. 504).

Some recent investigations concerning soil inoculation with pure cultures of tubercle bacilli for culture of legumes, F. NOBBE (*Chem. Ztg., 20 (1896), No. 80, pp. 785, 786*).—The following is an abstract of a paper presented by the author before the botanical section of the Association of German Naturalists and Physicians at the Frankfort meeting, September, 1896.

Experiments with sand and water cultures of various legumes and other plants were reported in which it was shown that legumes, Eleagnus, and possibly *Podocarpus angustatus* are able to fix free nitrogen through symbiosis with bacteria and not through their leaves. Mustard, oats, and buckwheat are said to be unable to assimilate free atmospheric nitrogen.

The relation of the various bacteria to one another and the effect of any specific bacteria upon a different host plant was shown, the latter phase having been recently given in much greater detail (see above).

Concerning the effect of inoculation upon nitrogen containing soils, it was shown that tubercle bacteria are rather sensitive toward certain chemicals. The formation of root tubercles was greatly retarded by the presence of potassium nitrate, while ammonium sulphate was without injurious effect. The following table shows the effect on hairy vetch of adding nitrate of potash to inoculated pots:

Yield of hairy vetch with and without potassium nitrate.

	Without nitrate.		With nitrate.			
			Furnishing 0.5 gm. nitrogen.		Furnishing 1 gm. nitrogen.	
	Dry matter.	Nitrogen.	Dry matter.	Nitrogen.	Dry matter.	Nitrogen.
	Gm.	*Mg.*	*Gm.*	*Mg.*	*Gm.*	*Mg.*
Not inoculated	5.72	90	22.87	390	32.64	625
Inoculated	43.12	1,420	48.64	1,660	62.25	2,520

The duration of efficiency of tubercle bacteria when cultivated upon gelatin was examined. It was found that in practice the vitality of the bacteria is not impaired within 2 or 3 months if the culture is kept from strong light. Cultures 7 months old were found to be worthless.

Concerning the after effect of inoculation upon crops, pots were inoculated with pea, robinia, and red clover bacteria, and the following year seeded with peas, robinia, and red clover. The dry matter of the harvested material was as follows:

Yield of dry matter from pots inoculated previous year.

	Inoculated with bacteria of—		
	Peas.	Robinia.	Red clover.
	Gm.	*Gm.*	*Gm.*
Peas	18.9	12.4	9.3
Robinia	.6	18.4	2.2
Red clover	9.9	9.0	14.4

A brief account is given of field experiments conducted during the past year with pure cultures of tubercle bacilli "nitragin." The results in 27 per cent of the trials were highly favorable to the use of "nitragin," 12 per cent were unfavorable, while in the other trials the results were negative.

The genus Brodiæa and its allies, J. G. BAKER (*Gard. Chron., ser. 3, 20 (1896), No. 519, p. 687, figs. 4*).—Critical notes are given of Brodiæa and allied genera, most of which grow in the Pacific States.

A new Viburnum from Missouri, W. DEANE and B. L. ROBINSON (*Bot. Gaz., 22 (1896), No. 2, pp. 166, 167, pl. 1*).—*Viburnum demetrionis* from western Missouri is figured and described as new.

A revision of the genus Tridax, B. L. ROBINSON and J. M. GREENMAN (*Proc. Amer. Acad. Arts and Sci., 32 (1896), No. 1, pp. 3–10*).

A revision of the genus Zinnia, B. L. ROBINSON and J. M. GREENMAN (*Proc. Amer. Acad. Arts and Sci., 32 (1896), No. 1, pp. 14–20*).

The Gramineæ: Descriptions, figures, and uses of the grasses growing spontaneously and cultivated in France, Belgium, Great Britain, and Switzerland, T. HUSNOT (*Graminées: Descriptions, figures et usages des Graminées spontanées et cultivées de France, Belgique, Iles Britanique, et Suisse. Cahan: 1896, pt. I, pp. 24, pls. 8*).

Notes for the description of Hymenomycetes, M. BRITZELMAYR (*Bot. Centbl., 68 (1896), No. 5, pp. 137–145*).

Mucor proliferus n. sp., W. SCHOSTAKOWITSCH (*Ber. deut. bot. Ges., 14 (1896), No. 8, pp. 260–263, pl. 1*).—This new species is described from Siberia.

Histological studies of the Uredineæ, SAPPIN-TROUFFY (*Le Botaniste, ser. 5, 1896, No. 2–5, pp. 59–244, figs. 69*).—Studies are given of the following genera: Uromyces, Puccinia, Gymnosporangium, Triphragmidium, Phragmidium, Melampsora, Theospora, Cronartium, Endophyllum, and Coleosporium, together with a general consideration of the nucleus, vegetative and reproductive apparatus, and fecundation.

New species of tropical fungi, J. B. ELLIS and B. M. EVERHART (*Bul. Lab. Nat. Hist. Iowa Univ., 4 (1896), No. 1, pp. 67–72*).—Fourteen new species are described from Mexico and Central America.

On the color reaction of the cuticle of Lactarius turpis, V. HARLAY (*Bul. Soc. Mycol. France, 12 (1896), No. 4, pp. 156–159*).

The philosophy of species making, L. H. BAILEY (*Bot. Gaz., 22 (1896), No. 6, pp. 454–462*).

Contributions to the anatomy of grass leaves, A. GROB (*Bibliotheca Botanica, 1896, No. 36; abs. in Bot. Centbl., 68 (1896), No. 7, pp. 220–222*).—Studies were made of the leaves of *Nardus stricta, Glyceria fluitans, Sesleria cœrulea, Olyra latifolia,* and *Bambusa verticillata.*

Concerning the alkaloids of the seed of Lupinus albus and L. angustifolius, L. S. DAVIS (*Inaug. Diss. Marburg, pp. 68*).

Investigations on certain organic acids in plants, A. BERG and C. GERBER (*Bul. Soc. Chim. Paris, ser. 3, 15–16 (1896), No. 18–19, pp. 1050–1055*).

On the formation of sugar in beets, F. STROHMER (*Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1896, p. 589; abs. in Bot. Centbl., 68 (1896), No. 7, pp. 233–235*).

On the presence of tyrosin in certain mushrooms, E. BOURQUELOT and V. HARLAY (*Bul. Soc. Mycol. France, 12 (1896), No. 4, pp. 153–156, fig. 1*).

The energy of living protoplasm, O. LOEW (*London: Kegan Paul, French, Trübner & Co., 1896, pp. 120*).

The chemistry of the living cell, A. GAUTIER (*Die Chemie der lebenden Zelle. Authorized translation, Wien: A. Hartleben, 1896, pp. IV, 130, figs. 11*).

Investigations on the division of the nucleus in the plant cell, C. DEGAGNY (*Bul. Soc. Bot. France, ser. 3, 3 (1896), No. 7, pp. 332–346*).

A review of the theories of water movement in plants, M. MÖBIUS (*Biol. Centbl., 16 (1896), pp. 561–571*).

Concerning the increased respiration and heat production after injury to living plants, W. PFEFFER (*Ber. math. phys. Classe kgl. sächs. Ges. Wissensch., 1896, July 27*).

Concerning the influence of light and temperature on turgor, E. B. COPELAND (*Inaug. Diss. Halle, 1896, pp. 59; abs. in Bot. Centbl., 68 (1896), No. 6, pp. 177–180*).

Death of plants at temperatures above the freezing point, H. MOLISCH (*Sitzungsber. kgl. Akad. Wissensch. Math. naturw. Classe, Wien, 105 (1896), No. 1; abs. in Bot. Ztg., 54 (1896), II, No. 23, pp. 362, 363*).

Dimorphism of the branches of Castilloa elastica, F. A. F. C. WENT (*Ann. Jard. Bot. Buitenzorg, 14 (1896), I, pp. 1–17, pls. 3*).

Concerning the abnormal formation of resin ducts in diseased conifers, A. P. ANDERSON (*Forstl. naturw. Ztschr., 5 (1896), No. 12, pp. 461–482, figs. 7*).

On the investigation of lignified membranes, F. ZETSCHE (*Ztschr. angew. Mikros., 2 (1896), No. 8, pp. 225–236*).

On the biology of woody plants in southern Chile, F. W. NEGER (*Engler's Bot. Jahrb., 23 (1896), No. 3, pp. 369–381, pl. 1*).

On the morphology of some conifer cones, J. SLAVICEK (*Oesterr. Bot. Ztschr., 46 (1896), No. 12, pp. 447–464*).

Internal antidromy, G. MACLOSKIE (*Torrey Bul., 23 (1896), No. 12, pp. 536, 537*).—Examples are cited of variation in the phyllotaxy of various conifers as well as Liquidambar and Hibiscus.

Internal frost injuries, R. HARTIG (*Forstl. naturw. Ztschr., 5 (1896), No. 12, pp. 483–488, figs. 7*).

Concerning the abnormal growth of grass stems, H. DINGLER (*Ber. deut. bot. Ges., 14 (1896), No. 8, pp. 295–300, figs. 2*).

Contribution to the physiology of the germination of Zea mais, F. LINZ (*Pringsheim's Jahrb. wiss. Bot., 29 (1896), No. 2, pp. 267–319*).

Effect of lengthening the peduncle on the dissemination of seed, E. ULE (*Ber. deut. bot. Ges., 14 (1896), No. 8, pp. 255–260, fig. 1*).

Some vagaries in strawberries due to bisexuality, P. MACOWAN (*Gard. Chron ser. 3, 20 (1896), No. 522, pp. 781, 782*).

A treatise of the anatomy and physiology of plants, L. COURCHET (*Traité de Botanique contenant l'anatomie et la physiologie végétales et les familles naturelles. Paris: J. B. Ballière et fils, 1896, pp. 900, figs. 800*).

Laboratory apparatus in vegetable physiology, J. C. ARTHUR (*Bot. Gaz., 22 (1896), No. 6, pp. 463–472, pls. 2, figs. 6*).—Illustrated descriptions of various forms of apparatus are given, among them an auxanometer, a centrifuge, a respirometer, and a hygrometer.

A handbook of microscopic technique, A. BÖHM and A. OPPEL (*Taschenbuch der mikroskopischen Technik. Munich: R. Oldenburg, 1896, pp. VI, 224*).

Some microchemical methods of investigation, E. ZACHARIAS (*Ber. deut. bot. Ges., 14 (1896), No. 8, pp. 270–280*).—Notes are given of the use of hydrochloric acid in microchemical investigations.

The saprophytic fungi of eastern Iowa, T. H. MCBRIDE and N. ALLIN (*Bul. Lab. Nat. Hist. Iowa Univ., 4 (1896), No. 1, pp. 33–66*).—Keys and descriptions are given for the determination of the Gasteromycetes, puff balls, of southeastern Iowa.

A contribution to the knowledge of tropical parasites, W. FIGDOR (*Ann. Jard. Bot. Buitenzorg, 14 (1896), I, pp. 213–240, pls. 2*).

History of the Swedish vegetation, G. ANDERSSON (*Engler's Bot. Jahrb., 22 (1896), No. 3, pp. 433–550, pls. 2, figs. 12*).—The author seeks to trace the origin of the flora of Sweden.

Popular American plant names, FANNIE D. BERGEN (*Bot. Gaz., 22 (1896), No. 6, pp. 473–487*).—The popular names are given for our plants from Ranunculaceæ through Compositæ, the sequence of Gray's manual being followed.

Terminology among the orders of Thallophytes, L. M. UNDERWOOD (*Torrey Bul., 23 (1896), No. 12, pp. 526–532*).—The author criticises and compares the terminology of von Tafel, Rehm, J. Schroeter, Zopf, Vines, and Warming, and gives his own ideas expressed in a very simple terminology.

FERMENTATION—BACTERIOLOGY.

On Bacillus mesentericus niger, J. LUNT (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 18, pp. 572, 573*).—The author describes a new bacillus which forms a black pigment on potatoes and thinks it probably identical with that recently described but not named by Biel.[1]

Concerning the structure of the Cyanophyceæ and bacteria, O. BÜTSCHLI (*Weitere Ausführungen über den Bau der Cyanophyceen und Bakterien. Leipzig: Engelmann, 1896, pp. 87, pls. 5, figs. 6; abs. in Bot. Centbl., 67 (1896), No. 6, pp. 164–168*).

Contribution to the study of yeasts of beer, E. BOULLANGER (*Ann. Inst. Pasteur, 10 (1896), No. 10, pp. 597–607*).

The yeasts, their morphological and physiological characters, E. KAYSER (*Les Levûres: Charactères, morphologiques et physiologiques; applications des levûres selectionées. Paris: Masson et Cie., pp. 195, figs. 19*).

Concerning the action of diastase, etc., on the starch grain, J. GRÜSS (*Beiträge wissensch. Bot., 1 (1895), pp. 295–315; abs. in Bot. Centbl. Beihefte (1896), No. 2–3, p. 123*).

On a new "oxydase" or soluble oxidizing ferment of vegetable origin, G. BERTRAND (*Compt. Rend., 122 (1896), No. 21, pp. 1215–1217; Rev. Sci., ser. 4, 5 (1896), No. 23, p. 726*).

A new soluble oxidizing ferment of vegetable origin, G. BERTRAND (*Compt. Rend., 123 (1896), No. 12, pp. 793–797; Bul. Museum Nat. Hist. Paris, 1896, No. 5, pp. 206–208*).

Concerning a dextrin fermenting yeast and its ultimate introduction into practice, F. ROTHENBACH (*Bot. Centbl. Beihefte, 6 (1896), No. 4, pp. 308–318*).

Oxidizable compounds under the influence of the oxidizing ferments of fungi, E. BOURQUELOT (*Compt. Rend., 123 (1896), No. 5, pp. 315–317*).

The effect of enzyms on the living cell and the theory of their action, C. FERMI (*Centbl. Physiol., 7 (1895), No. 21; abs. in Centbl. Bakt. und Par. Med., 20 (1896), No. 6–7, pp. 233–235*).

Influence of the reaction of the medium on the activity of the oxidizing ferment of fungi, E. BOURQUELOT (*Compt. Rend., 123 (1896), No. 4, pp. 260–263*).

Concerning the effect of salt upon the working of phenols, J. W. BECKMAN (*Centbl. Bakt. und Par. Med., 20 (1896), No. 16–17, pp. 577–580*).

Action of the soluble oxidizing ferment of fungi on phenols insoluble in water, E. BOURQUELOT (*Compt. Rend., 123 (1896), No. 9, pp. 423–425*).

The physiological conditions for the endogenous spore formation of Bacillus anthracis, B. subtilis, and B. tumescens, O. SCHREIBER (*Centbl. Bakt. und Par. Med., 20 (1896), Nos. 10–11, pp. 353–374; 12–13, pp. 429–437*).

The relation of antitoxins to their specific organisms, E. KLEIN (*Centbl. Bakt. und Par. Med., 20 (1896), No. 12–13, pp. 417–420*).

On the resistance of bacteria to dry heat, A. CAMBIER (*Ann. Micr., 1896, No. 2, pp. 49–54*).

Concerning the influence of induction electricity on bacteria, E. VON FREUDENREICH (*Centbl. Bakt. und Par. Med., 20 (1896), No. 14–15, pp. 505–508*).

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[1] Centbl. Bakt. und Par. Allg., 2 (1896), No. 5, p. 137.

Do Röntgen rays exert an influence upon bacteria? J. WITTLIN (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 21, pp. 676, 677*).—From the author's experiments he thinks Röntgen rays exert no influence whatever upon bacteria.

A contribution on the gases produced by certain bacteria, L. H. PAMMEL and E. PAMMEL (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 20, pp. 633–650, pl. 1*).

Concerning crystal formation in nutrient media, J. NOWAK and S. CIECHANOWSKI (*Centbl. Bakt. und Par. Med., 20 (1896), No. 18–19, pp. 679, 680*).

Disinfection by vapors of formic aldehyde, L. VAILLARD and G. H. LEMOINE (*Ann. Inst. Pasteur, 10 (1896), No. 9, pp. 481–487*).

A self-regulating pasteurizing apparatus, V. HENRIQUES and V. STRIBOLT (*35. Beretning fra den Kgl. Veterin. og Landbohöjskoles Laborat. for landökonom. Forsög.; abs. in Chem. Ztg., 20 (1896), No. 88, Repert., p. 260*).

A practical method for preparing agar for cultures (*Ztschr. angew. Mikros., 2 (1896), No. 8, p. 237*).

Egg yolk as a nutrient medium for bacterial cultures, A. CAPALDI (*Centbl. Bakt. und Par. Med., 20 (1896), No. 22–23, pp. 800–803*).

A new method of making pure cultures of yeasts and similar organisms, H. WILL (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 15, pp. 483–497*).

Concerning bacterial plate cultures, M. JEGUNOW (*Centbl. Bakt. und Par. Allg., 2 (1896), Nos. 14, pp. 445–449; 15, pp. 478–482, pls. 2*).

A new culture oven for bacteria, etc., F. SARTORIUS (*Ztschr. angew. Mikros., 2 (1896), No. 5, pp. 129–133, figs. 2*).

Modern theories of fermentation, with notes on the morphology and culture of yeasts, F. WYATT (*Jour. Franklin Inst., 142 (1896), Nos. 4, p. 286; 5, p. 336*).

Concerning the nomenclature of the so-called tubercle bacillus, A. COPPEN-JONES (*Centbl. Bakt. und Par. Med., 20 (1896), No. 10–11, pp. 393–395*).

The present position of systematic bacteriology, C. MEZ (*Bot. Centbl., 68 (1896), No. 7, pp. 203–211*).

The bacteriological examination of water for typhoid bacillus, T. H. PEARMAIN and C. G. MOOR (*Analyst, 21 (1896), p. 117*).

ZOÖLOGY.

Field experiments devised for the destruction of mice by means of the bacillus isolated from the Casan marmot [Spermophilus citillus], S. S. MERESHKOWSKY (*Centbl. Bakt. und Par. Med., 20 (1896), Nos. 2–3, pp. 85–94; 4–5, pp. 176–187*).—The author describes experiments in which the organism was fed to mice by mixing bouillon containing it with rye flour and distributing this dough cut into small pieces over the area to be infected.

On the acclimatization of organisms to high temperatures, C. B. DAVENPORT and W. E. CASTLE (*Arch. Entwickl. Organismen, vol. 2, No. 2; abs. in Bot. Centbl., 68 (1896), No. 9, pp. 292, 293*).

The differentiation of organisms, A. L. ABBÉ (*Rev. Sci., ser. 4, 6 (1896), No. 25, pp. 774–779*).

List of mammals of the District of Columbia, V. BAILEY (*Proc. Biol. Soc., Washington, 10 (1896), pp. 93–101*).—This is an annotated catalogue of 38 species known to occur within a radius of 20 miles from the Capitol, and most of them within the District limits. Brief observations on the habits and on some individual specimens collected are included.

Taxidermy: How to collect, skin, preserve, and mount birds, B. H. WARREN (*Pennsylvania Dept. Agr., Division Economic Zoölogy Bul. 6, pp. 128, figs. 11*).—A condensed account is given of methods for collecting, skinning, preserving, and mounting birds, together with the game and fish laws of the State.

The preservation of museum specimens with retention of their natural colors, C. KAISERLING (*Wiener klin. Wochenschr., 33 (1896), p. 35; abs. in Chem. Ztg.,*

20 (1896), No. 88, Repert., p. 258).—As the result of experiments in this direction the author has settled upon the following solution as the best: Formalin 750 cc., distilled water 1,000 cc., *kalium nitricum* 10 cc., and *kalium aceticum* 30 cc. Generally 24 hours' treatment in this solution is said to be sufficient. The specimens are then drained and placed in 80 per cent alcohol. They are usually kept finally in a mixture of equal parts of water and glycerin and 30 parts of potassium acetate.

General principles of zoölogy, R. HERTWIG, translated by G. W. FIELD (*New York: Henry Holt & Co., 1896, pp. 226, figs. 110*).—This volume is a translation of the first part of Hertwig's "Lehrbuch der Zoölogie," and treats of general zoölogy. The history and development of the various branches of zoölogy are given at considerable length, and also the bearing of zoölogy upon various theories of evolution. General anatomy, embryology, the relation of animals to each other and to plants, and geographical distribution are each treated in considerable detail. The broad generalizations of the author can not fail to interest those who are not already acquainted with them from the original.

METEOROLOGY.

On periodicity of good and bad seasons,[1] H. C. RUSSELL (*Nature, 54 (1896), No. 1399, pp. 379, 380*).—The dates of recorded droughts, *i. e.*, "periods of months or years when little rain falls," have been collected with a view to determining the period of their recurrence. It is first shown that during the 108 years since the foundation of the colony of New South Wales "the most pronounced droughts recur with great regularity; that is, at every 19 years." This period was also found to hold for Indian droughts.

"Another set of dry periods, more intense and relatively shorter than the first series, was found also to recur at intervals of 19 years. One of these droughts falls regularly between a pair of the more extensive droughts previously referred to.

"History says very little about droughts prior to A. D. 900." It records droughts on 44 of the 52 dates indicated in 19-year periods between that year and the present time, and 6 of the 8 missing droughts occur between 900 and 1000, an interval when history was very incomplete.

"Records of 20 B. C. droughts were found, all of which, with one exception, fit into our 19-year cycle. The intervals between them are multiples of 19 years. . . .

It appears that "this law of climate was well known to the Jews, the Egyptians, and other ancient peoples; they at least knew how to forecast droughts successfully."

The author considers the moon the prime motor in this periodic occurrence of droughts. Investigations on this subject are still unfinished, but the results thus far obtained indicate that—

"When the eclipses congregate about the equinoxes—that is, in March and September—they do so in the years which give us great droughts. Further, that when the eclipses accumulate in February and March, that is, at the vernal equinox and the month before it, and September, the autumnal equinox, and the month before it,

[1] Read before the Royal Society of New South Wales, June 3, 1896.

August, we have the more intense and relatively shorter droughts of the second series, with heat, gales, and hurricanes; on the other hand, when they accumulate about March and April, that is, the month of the equinox, and the one following, and about September, the month of equinox, and October following it, we have droughts of the first series that are less severe, but much longer than the droughts of the second series."

Incidentally the recorded dates of "red rain," which are evidences of drought, were collected. All of the 69 instances found fitted into the 19-year cycle.

Kite experiments at the Weather Bureau, C. F. MARVIN (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24 (1896), Nos. 4, pp. 113–123, figs. 26; 5, pp. 156–166, figs. 30; 6, pp. 199–206, figs. 8; 7, pp. 238–255, figs. 16*).—The history of the use of kites for the purpose of studying atmospheric conditions is briefly reviewed. It is shown that probably the earliest attempts to use tandem kites for this purpose were made by Alexander Wilson, of Glasgow, in 1749. The first in the United States to use the cellular kites constructed after the model of Hargrave, of Sydney, Australia, were C. H. Lamson, J. B. Millet, and S. A. Potter.

A detailed account is given of the scientific methods pursued by the Weather Bureau in the construction and testing of kites of various kinds. Data for tests of the strength of various kinds of wire and string unknotted and knotted in various ways are tabulated and discussed. A careful analysis is also given of the forces acting on kites—pull, drift, resolution and combination of forces, wind pressure on plane surface, center of pressure, edge pressures, resultant pressure, pressure on thin curved surfaces, effect of waviness or fluttering, whirls or eddy effects, lateral stability, longitudinal stability, and conditions that modify the angular elevation of the kite, and an elaborate description and discussion is given of the forms and construction of various kites experimented with by the Weather Bureau, giving mathematical formulas and methods and results of observations on the behavior and efficiency of the kites tested.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24 (1896), Nos. 4, pp. 105–144, charts 9; 5, pp. 145–190, charts 12, figs. 3; 6, pp. 191–228, charts 6; 7, pp. 235–255, charts 8*).—Besides the usual monthly summaries of observations and lists of recent publications on meteorology, these numbers contain an illustrated article on kite experiments at the Weather Bureau, by C. F. Marvin (see above). In addition, No. 5 contains articles on the destructive forces of hurricanes and the conditions of safety and danger, by E. P. Alexander; report on the tornadoes of May 25 in the State of Michigan, by N. B. Conger, and notes by the editor on long-range forecasts, frosts in California, total snowfall for the season 1895–'96, Röntgen rays and cloudy condensation, and the tornano of May 25, 1896, in Cook County, Illinois. No. 6 contains notes by the editor on Mexican climatological data, and on kites, balloons, and clouds; and No. 7, articles on kites in

Montana, by A. B. Coe; and sunshine at the Southern California agricultural experiment farm, near Pomona, California, and a note by the editor on the St. Louis tornado.

Report of the meteorologist, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 208–228*).—Monthly summaries of observations at 6 stations in the State on temperature, pressure, and rainfall are given. A summary of temperature and rainfall observations for the year 1894 is given in the following table:

Annual summary of meteorological observations in Delaware.

	Newark.	Middletown.	Dover.	Milford.	Seaford.	Millsboro.
Temperature (°F.):						
Highest	96.20	96.00	100.00	95.50	98.00	97.50
Lowest	4.00	7.00	6.00	10.00	9.00	9.00
Mean	52.50	54.30	55.10	56.20	55.60	55.50
Rainfall (inches) total	50.49	56.89	45.84	46.88	38.89	46.00
Number of days on which 0.01 inch or more of rain fell	101	99	102	111	103	120

Meteorological summary (*Mississippi Sta. Rpt. 1895, pp. 106, 107*).—Tabulated monthly summaries are given of observations on rainfall for 7 years (1889–1895) and wind movement for 6 years (1890–1895), and on temperature, rainfall, wind movement, and cloudiness for 1895.

The more important data in these summaries are as follows: *Temperature* (degrees F.), maximum, 97, June 2; minimum, 2, February 8; range, 95 (1895), 85.2 (for 6 years). *Precipitation* (inches), total, 47.49 (1895), 50.19 (for 7 years); number of clear days, 132; partly cloudy, 186; cloudy, 47; rainy, 91. *Wind* (prevailing direction), SE.; total movement, 61,846 miles (1893), 68,201 (for 6 years). *Sunshine*, number of hours recorded, 2,515½.

The use of kites for meteorological observations in the upper air, H. H. CLAYTON (*Nature, 55 (1896), No. 1416, p. 150*).—A brief account is given of observations with a meteorograph (which records temperature, pressure, and humidity) carried by a kite to a height of a mile.

Meteorological records, E. A. BEALS (*Minnesota Sta. Rpt. 1895, pp. 390-392*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 207).

Meteorological observations at Münster, 1884-1895, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 257–261*).—Monthly summaries of observations on temperature, barometic pressure, and precipitation.

The Congress of Clermont-Ferrand (1896). Section of climatológy (*Jour. Hyg., 21 (1896), No. 1051, pp. 549–551*).

WATER—SOILS.

The texture of the soil, L. H. BAILEY (*New York Cornell Sta. Bul. 119, pp. 407–412, figs. 3*).—It is stated that this bulletin and others of the same series "are written for the purpose of giving their readers a few simple and primary lessons in some of the most fundamental subjects connected with the cropping of the land. . . . It is their sole ambition to teach, not to discover or to record." The series is published under recent State legislation (chapter 437, laws of 1896), which

among other provisions, appropriates money for "disseminating horticultural knowledge" in the fourth judicial department of the State. It is the intention to use these bulletins in the schools of horticulture which are to be held under the auspices of this State grant.

The bulletin reports analyses of an unproductive clay on which beans failed to grow, of an adjacent soil on which they grew well, and of a lime rock derived from the same locality. The results were as follows:

Analyses of productive and unproductive soils and of lime rock.

	Moisture.	Nitrogen.	Phosphoric acid.	Potash.	Lime.	Organic matter.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Unproductive clay	13.25	0.08	0.20	1.10	0.41	3.19
Good bean land	15.95	.11	.17	.75	.61	5.45
Lime rock	....	....	.08	2.12	2.55	....

The table shows that the soil upon which the beans would not grow is richer in mineral plant food than the productive soil and that the rock contains an abundant supply of potash and about half as much phosphoric acid as the good bean soil. The unproductive soil, however, was in poor mechanical condition and was deficient in organic matter (humus).

The bulletin briefly discusses the importance of the physical condition of the soil and the value of chemical analysis in determining the requirements of the soil, summarizing as follows:

"The first step in the enrichment of unproductive land is to improve its physical condition by means of careful and thorough tillage, by the addition of humus, and perhaps by underdrainage. It must first be put in such condition that plants can grow in it. After that, the addition of chemical fertilizers may pay by giving additional or redundant growth."

The moisture of the soil and its conservation, L. A. CLINTON (*New York Cornell Sta. Bul. 120, pp. 415–436, figs. 11*).—This bulletin is the second of the series published under recent State legislation providing, among other things, for "disseminating horticultural knowledge." It discusses in clear, popular manner the following subjects: How the soil holds water, the necessity of water for growing plants, the conservation or saving of moisture, plowing to save moisture, harrowing to save moisture, cultivators and conservation of moisture, the roller in its relation to soil moisture, herbage mulches, humus of the soil, underdrainage, mineral substances as conservers of moisture, wind-breaks to save moisture, selection and management of crops in relation to soil moisture, and suggestions for determining the amount of moisture in soils.

Soil moisture, 1895, J. B. WEEMS and W. H. HEILEMAN (*Iowa Sta. Bul. 32, pp. 505–515*).—The results are reported of determinations of moisture in samples of soil taken each week from April 9 to October 29, 1895, from plats on which clover, corn, oats, beets, and blue grass

were grown, together with data for rainfall and maximum temperatures during the same period. Samples were taken at the following depths: Top to 4 in., 4 in. to 1 ft., 1 ft. to 2 ft., 2 ft. to 3 ft., and 3 ft. to 4 ft. They were well mixed before the moisture was determined.

In the clover field the first 2 ft. of soil was black loam of uniform and good quality, the third foot fine gravel and grayish clay, and the fourth gravel and clay. In the corn field the first 2 ft. of soil was loamy, the third yellowish clay loam mixed with black loam, and the fourth yellow sandy loam. In the oat field the soil was of the same character as that of the corn field. In the root field the soil was similar to that of the preceding plat down to a depth of 3 ft., the third foot being black loam mixed with yellowish timber clay, and the fourth consisting of stiff yellowish clay and fine gravel. In the pasture soil the first 2 ft. was loamy, the third foot fine, sandy, brown loam, the fourth fine, sandy, yellowish loam.

The averages of the results obtained on these soils during the 30 weekly periods are given in the following table:

Moisture in the soil at different depths.

	Moisture at different depths.					Average weekly rainfall.
	Top to 4 in.	4 in. to 1 ft.	1 ft. to 2 ft.	2 ft. to 3 ft.	3 ft. to 4 ft.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Inch.*
Clover plat	21.18	19.59	16.55	14.45	11.73	0.84
Corn plat	14.12	15.01	14.22	11.49	9.50	.84
Oat plat	14.07	12.37	10.66	11.50	11.54	.84
Mangel-wurzel plat	17.66	17.21	15.17	14.76	13.85	.84
Blue-grass plat	14.16	13.98	13.75	11.50	10.00	.84

The difference between the number of tons of water present in the soil at the beginning and end of growth as calculated from the above figures, added to the rainfall, is assumed to be the amount which disappeared from the soil in the production of the different crops. This was estimated to be 1,559.64 tons of water per ton of clover hay, 570.89 tons per ton of air-dry corn fodder, 1,200 tons per ton of oats and straw, 137.49 tons per ton of mangel-wurzels, and 3,223.82 tons per acre of pasture.

On the changes which the soil undergoes when sterilized, L. RICHTER (*Landw. Vers. Stat.*, *47* (*1896*), *No. 4–5*, *pp. 269–274*).—Irregularities in the growth of plants in pots of sterilized soil, which could not be explained by the presence or absence of microörganisms, led to a study of the water content, weight by volume, specific gravity, porosity, capillarity, absorptive power for water and ammonia, total nitrogen, nitrogen soluble in dilute hydrochloric acid, ammonia, and matter soluble in cold water in soil used in pot experiments before and after sterilization. It was found that the capillary rise of water in sterilized soil was irregular on different sides of the soil column. The differences were greater the greater the length of time of the test. They were

not appreciable at the end of 12 hours, but were as great as 1 cm. after 24 hours and 2 cm. after 48 to 72 hours. The same peculiarity was shown when an attempt was made to moisten the sterilized soil, certain well-defined zones remaining dry while the rest was thoroughly wet. While the total nitrogen was not affected, a part of it was changed into readily soluble (soluble in HCl, sp. gr. 1.026) forms by sterilization of the soil. The amount so changed was increased by wetting the soil previous to sterilizing. Some of the transformed nitrogen was in very unstable condition and was easily driven off as gas.

It was observed in the pot experiments carried out that there was a loss of nitrogen in the sterilized soil whether it was subsequently inoculated with soil extract or not, although the loss was generally less in the latter case. The same was true in case of inoculated soils not bearing plants, while the uninoculated soils in no case showed a loss and in some instances a small gain.

The amount of water-soluble organic matter was increased almost three times in the sterilized soil, and the more vigorous growth of plants in the sterilized soil is thus, in part, explained.

Decomposition of vegetable matter in the presence of water and soil, E. BRÉAL (*Ann. Agron., 22 (1896), No. 8, pp. 362–375.*)—The character of the organisms found in infusions of dead plants is briefly discussed and investigations on the formation of ammonia by these organisms from nitrogenous matter and on their influence upon the nitrifying organisms are reported, together with a description of the methods used in determining ammoniacal and nitric nitrogen.

The character of these investigations and the principal results obtained are shown in the following summary:

Infusions of dead plants contain numerous organisms which attack organic matter producing ammonia from nitrogenous matter.

Their activity is checked when the ammonia becomes too abundant, the highest amount observed in such cases being 0.2 gm. ammoniacal nitrogen per liter.

If the infusion contains organisms which destroy ammonia the latter may continue to be formed. This is the case when the nitrifying organism is present. Passing a current of air through the medium greatly accelerates nitrification, and as a consequence the production of ammonia.

Similar results are obtained when a lump of soil is moistened with the infusion. At the surface ammonia disappears and nitric nitrogen takes its place. In the interior ammonia accumulates because the nitrifying ferment cannot act there, a part of the nitric nitrogen originally present being reduced.

A soil treated with an infusion containing organisms which produce ammonia is likely to undergo nitrification more rapidly than one not so treated. Unusual activity of the nitrifying ferment seems to be excited under this condition.

Humus, which is insoluble in water, was found to be soluble in the infusion on account of the ammonia formed, but the humus was again rendered insoluble by adding to the infusion a little soil containing nitrifying ferments.

Less ammonia and more nitrate was found in the soil with which vegetable remains were intimately mixed than in the one on which this matter was simply spread on the surface. The stirring attending the incorporation of such matter in the soil, of course, accelerated nitrification.

When the production of ammonia has proceeded to the point of destroying the organisms producing it, fungi appear which convert the ammonia into organic compounds again. In meadows, peat bogs, etc., in which vegetable matter accumulates the nitrifying ferment does not exist, but fungi feed on the ammonia formed and thus enable the organisms producing the ammonia to continue their activity. What is meat for the former is poison for the latter.

On the cultivation of the soil, P. P. DEHÉRAIN (*Ann. Agron., 22 (1896), No. 10, pp. 449–469*).—This is the first paper of a proposed series and is devoted to the aëration of the soil.

Samples of soil were taken by driving down into the soil *in situ* boxes 7.87 in. square and 5.91 and 7.87 in. deep, and removing the prisms of soil thus inclosed. These were weighed, dried, and weighed again. If A = the actual volume of the soil, B the volume of the water it contains, D the density of the dry soil, and X the air which the soil contains, then V (original volume of the soil) $= \frac{A}{D} + B + X$, from which X is easily calculated. This method was applied to numerous samples representing meadow and forest soils, spaded soil, and soil plowed in autumn and afterwards cultivated in the spring (harrowed and rolled). The results show that the above method gives approximately accurate results, check determinations agreeing closely. It appears that uncultivated soil contains considerable amounts of air. This is true of meadow and forest soil as well as that covered with spontaneous vegetation. While much more air was found in cultivated than in uncultivated soils, this difference was hardly sufficient to explain the utility of cultivation. A light soil left to itself undergoes internal rearrangement of particles which increases the total space. Rolling reduces this space and decreases aëration. Harrowing to break clods is very important because clods exposed to the air lose all of their oxygen, and consequently the oxidation of the organic matter is interfered with. Unseasonable cultivation which produces clods therefore seriously interferes with the aëration of the soil.

The influence of irrigation on meadows, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 142–152*).—This is a summary of work in this line at the Münster station during the last 20 years, upon

which several reports of progress have been made.[1] The importance of water in plant growth is discussed, and the warming effect of irrigation water in the fall and spring and its cooling effect in summer is pointed out.

It is shown that irrigation water properly applied is a powerful means of oxidation and of purification of the soil from harmful products. This oxidation results in the formation of carbon dioxid, which largely increases the solution of lime. The observations on the extent of oxidation and solution of lime in peaty, calcareous, loam, and sandy soils are reported. The action is greater in summer than at other seasons, hence the need of greater caution in the use of water at this time.

The fertility which the water contains is a very important factor in irrigation, especially during the growing season. The benefit derived from this source is due chiefly to the fertility taken up directly by the plant and to much less extent to that absorbed by the soil. The benefit is greater on poor soils than on those of better quality. In fact, on rich soils there is a loss of fertility by irrigation. The amount of the different constituents so removed does not depend upon their absorbability, nitrate apparently being taken up in as large quantities as ammonia, potash, and phosphoric acid. The benefit to be derived from the use of irrigation water depends, therefore, largely upon the fertility of the soil and the vigor and extent of plant growth. The poorer the soil and the larger and more vigorous the plant growth the greater the benefit from the fertilizing constituents of the irrigation water.

As compared with the other soils experimented with, the sandy soil gave the best results from irrigation. This was especially true when sewage and similar materials which require free access of oxygen for their decomposition were used.

Ordinary brook and river water generally furnish sufficient lime, potash, and nitrogen for irrigated meadows. Of phosphoric acid, 36 lbs. per acre in the form of superphosphate or 54 to 72 lbs. in the form of Thomas slag may be used with advantage, the first in the spring, the latter in the fall. Occasionally potash and nitrogen may be needed, but the latter should be applied very sparingly.

Methods of the mechanical analysis of soils, M. WHITNEY (*U. S. Dept. Agr., Division of Agricultural Soils Bul. 4, pp. 24*).—This is a detailed description of the methods in use in the Division of Soils of this Department "for the mechanical analysis of soils and for the determination of the amount of moisture in arable soils." The bulletin "is intended partly for the instruction of the observers and special agents of the Division, and partly for the information of workers in the agricultural colleges and experiment stations and other institutions or organizations which are interested in similar lines of work and who

[1] Landw. Jahrb., 6 (1877), p. 287; 8 (1879), p. 505; 9 (1882), pp. 151, 158; 14 (1885), p. 177; 22 (1893), p. 801.

wish specific information as to methods." The topics treated are: Collecting samples of soil from the field, including where samples should be taken, how samples should be taken, importance of taking samples at uniform depth, sacks for collecting soil samples, and forms for description of samples; methods of mechanical analysis of soils, including preparation of the samples, method of determining the amount of moisture and organic matter, method of mechanical analysis, and interpretation of the results; and determination of moisture in arable soils, including how samples should be taken, errors liable to occur in taking samples, time of taking samples, depth at which samples should be taken, form for description of samples, cultivation and cropping, location of plats, how plats should be laid off and treated, and method of determining the amount of moisture in samples.

Ammonia in rain water (*Mississippi Sta. Rpt. 1895, p. 102*).—The amounts of nitrogen in different forms in rain collected during 11 months in 1894 and 12 months in 1895 are reported. The total nitrogen found in the rainfall for 11 months of 1894 was 2.847 lbs. per acre; in 1895, 3.308 lbs.

The domestic filtration of water, F. ABBA (*L'Ingegneria Sanitaria, Torino, 1895, No. 7–8; abs. in Centbl. Bakt. und Par. Med., 20 (1896), No. 22–23, pp. 840–842*).

Mineral waters (*Mississippi Sta. Rpt. 1895, pp. 103, 104*).—Tabulated analyses of 20 samples of mineral water. "Salts of lime are the most conspicuous ingredients in the waters of this State, though salts of magnesium, sodium, iron, and potassium are present in greater or less quantities."

Examinations of drinking water (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 37–90*).—This is a part of the review of the work of this station from its organization to the present time, and gives in tabular form the results of examinations with reference to sanitary quality of a large number of samples of drinking water from a variety of sources, as well as complete analyses of several samples of mineral water, and brook and river waters.

A problem of aridity, C. M. HARGER (*North Amer. Rev., 163 (1896), No. 6, pp. 711–715*).—The almost incredible decrease in values and the exodus of settlers from the far West, especially the western part of Kansas and Nebraska, and the causes of the same, are discussed.

The cultivation of marshes, O. AUHAGEN (*Landw. Jahrb., 25 (1896), No. 4–5, pp. 619–874, figs. 5*).

Clays (*Mississippi Sta. Rpt. 1895, p. 105*).—Tabulated analyses of 8 samples of clay. "Clay constitutes one of the most valuable minerals in the State, and large beds of excellent pottery and fire clay are found in different sections."

Marls (*Mississippi Sta. Rpt. 1895, pp 98, 99*).—Tabulated analyses of 71 samples of Mississippi marls. Marls are abundant in Mississippi, but of rather inferior quality.

Soils, H. SNYDER (*Minnesota Sta. Rpt. 1895, pp. 3–79, figs. 9, pl. 1, chart 1*).—A reprint of Bulletin 41 of the station (E. S. R., 7, pp. 476, 477, 484).

Soils (*Mississippi Sta. Rpt. 1895, pp. 95–97*).—Analyses of 47 samples of soils are tabulated.

Examinations of peat, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 125–127*).—Analyses of peats from a variety of sources are tabulated.

Tile drains (*Mississippi Sta. Rpt. 1895, pp. 52–55*).—This is a brief account of the experience of the station since 1889 on tile-drained land of different character (E. S. R., 6, p. 847).

FERTILIZERS.

On the effect of composting on certain phosphates, T. PFEIFFER and H. THURMANN (*Landw. Vers. Stat., 47 (1896), No. 4–5, pp. 343–356*).—The literature of the subject is reviewed, and as preliminary to the main investigation different methods of determining phosphoric acid were tested on pure monopotassium phosphate, and various commercial phosphates, some of which are used as manure preservatives. With the molybdic method in the first case (with pure phosphate) there was no difference whether the solution was allowed to stand 12 hours or heated 20 minutes in a boiling water bath. A large excess of magnesia mixture gave too high results. Direct precipitation from citrate solution gave good results.

Citrate solutions of superphosphate-gypsum, "magnesia-preparation" "precipitate," double superphosphate, and crude phosphate were prepared by Wagner's method and tested by various methods. In the cases of precipitate and double superphosphate, the further addition of citrate solution was necessary before exact results could be obtained by precipitation with molybdic solution and magnesia mixture. The effect of varying the amount of solvent used was also tested. The first two dissolved more readily when the proportion of solvent to material was 500 cc. to 5 gm. than when it was 500 cc. to 2.5 gm. With 2 per cent citric acid solution the larger the proportion of solvent to material the greater the amount of phosphoric acid dissolved in every instance.

A compost of ground peat and urine was prepared and portions were placed in flasks, to which the various preservative materials were added. The mixtures were weighed and examined June 10 and allowed to stand until December 19, when they were weighed and examined again to determine changes in both phosphoric acid and nitrogen. Where the crude phosphate and magnesia preparation were used as preservatives there was a practically insignificant increase of citrate soluble phosphoric acid. With the superphosphate-gypsum, on the other hand, there was such a great decrease as to indicate the formation of tricalcium phosphate from monocalcium and dicalcium phosphate in the presence of the ammonia and ammonium carbonate formed.

There was a considerable loss of nitrogen from the compost in every case, but it must be remembered that a large part of the nitrogen was originally in a very easily decomposable form. It appears, however, that the use of preservatives is at best only one of the means of preventing the loss of fertilizing value of manure. The proper construction of the manure heap is probably a more important means.

The value of leather refuse, J. B. LINDSEY (*Jour. Amer. Chem. Soc., 18 (1896), No. 7, pp. 565–575*).—This records a continuation of work commenced in 1894,[1] and gives the results of experiments on oats during

[1] Massachusetts State Sta. Rpt. 1894, p. 290; Agl. Sci., 8 (1894), Nos. 2, p. 49; 3, p. 98.

1894 and 1895. The plan of experiment and the materials used were practically the same during each year. The conclusion is drawn "that dissolved leather when properly prepared yields as available a source of nitrogen as the average animal matter used for fertilizing purposes. The quantity of nitrogen obtained by the plants from sodium nitrate being represented as equal to 100, the quantity obtained from dissolved leather during 2 years has been shown to be equal to 70."[1]

The rôle of fat in fertilizers, J. H. VOGEL (*Deut. landw. Presse, 23 (1896), No. 74, p. 659*).—It is stated that in all fertilizers applied in the fall or early spring a certain amount of fat, such as is present in poudrette, is beneficial. This is especially true in case of sandy soils in which it is desirable to retard decomposition of organic matter. Only in cases where quick action of the nitrogen is desired is fat harmful.

Fertilizers (*Mississippi Sta. Rpt. 1895, pp. 48–52, 99–101*).—This is a general discussion of the most economical use of fertilizers based upon the experience of the station in the use of fertilizers on different kinds of soil and analyses and valuations of 28 samples:

"The first essential in fertilizing land is to secure and maintain an abundant supply of humus in all soils by the use of leguminous plants; on soils which are rich in lime use potash freely with but little phosphoric acid; on soils which are poor in lime use phosphate fertilizers freely with but little potash, and use nitrogenous fertilizers only where humus is deficient and plant growth is weak.

"When large amounts of fertilizers have been used we have found it more profitable to apply them broadcast before planting, but where the application is small (300 lbs. or less per acre) we found it better to put it in the drill and mix thoroughly with the soil."

The contest of the Holland experiment stations against the adulteration of kainit with chlorids, A. MAYER (*Landw. Vers. Stat. 47 (1896), No. 4–5, pp. 377–387*).—Sjollema, of the Groningen station, has published analyses of kainit collected in Holland which contained very variable amounts of chlorin, in the majority of cases much more than genuine kainit contains. Subsequently in reporting the results of analyses of such materials the rule was adopted of stating that those samples containing an excessive amount of chlorin (over 30 per cent) were not true kainits. This has provoked the opposition of the fertilizer manufacturers, but it is insisted that they have no right to sell much of the potash salt at present on the market under the name of kainit. They are justified in using only some such general term as "potash salt" to designate it.

Report for 1895 of the chemical laboratory of the Agricultural Institute of Alnarp, M. WEIBULL (*Chem. Ztg., 20 (1896), No. 67, pp. 649, 650*).—A brief report on the analyses made, such as fertilizers (including herring guano), feeding stuffs, and dairy products. Herring guano is said to be manufactured at 16 factories on the west coast of Sweden. Several samples analyzed contained 10.5 per cent of nitrogen,

[1] Connecticut State Sta. Rpt. 1895, p. 99 (E. S. R., 8, p. 387).

4.2 per cent of phosphoric acid, and 0.8 per cent of potash. The fat content, formerly 11 to 16 per cent, was in some cases as low as 2.5 per cent.

The water content of 618 samples of butter from 115 creameries was determined. This varied from 10.3 to 17.29 and averaged 13.72 per cent.

On the supposition that stable manure is used, in what manner can the system of farming light soils be changed, or modified, so as to secure a higher net yield? K. GEIGER (*Deut. landw. Presse, 23 (1896), Nos. 83, pp. 742, 743; 84, p. 753; 87, p. 775; 88, p. 784; 89, pp. 790, 791; 90, pp. 800, 801; 91, p. 807; 92, pp. 816, 817*).

Influence of the proportion of the fertilizing constituents on the yield, J. RAULIN (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 404–409*).

Humus and mineral fertilizers, MAIZIÈRES (*L'Engrais, 11 (1896), No. 51, pp. 1211–1213; 52, pp. 1235, 1236*).—An argument in favor of keeping the soil well supplied with organic matter, especially by means of green manures, etc., when chemical fertilizers are used.

The management of barnyard manure, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 208–215*).—This is a review of the work of this station in this line since its organization[1] as well as of the work of other investigators.

The conclusions reached are that the manure pile must be carefully constructed and protected from extremes of moisture and sunshine. It should be kept moist but not wet. It is well to turn cattle in upon it occasionally to tramp it down, and thus exclude excess of air. When the heap is completed it should be covered with earth. If these precautions are observed the use of preservatives may be dispensed with. The profitableness of the use of the latter in any case is determined by their cost.

Conservation of stable manure, L. GRANDEAU (*Jour. Agr. Prat., 60 (1896), II, No. 47, pp. 747–750*).

Examinations of lime, limestone, and marl, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 90–124*).—Analyses of a large number of samples of these materials are tabulated and the rôle of lime as a fertilizer is discussed.

Origin of the nitrate of Chile, W. NEWTON (*Rev. Agron. Louvain, 15 (1896), No. 2, pp. 122–127*).

Nitrate deposit in South Africa (*L'Engrais, 11 (1896), No. 51, p. 1216*).—An extensive deposit of nitrate of potash is reported about 25 miles north of Pretoria.

Notes on fertilizing with phosphoric acid, TANCRÉ (*Fühling's landw. Ztg., 45 (1896), No. 24, pp. 732–740*).

Experiments with fertilizers at the Münster Station, Germany, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 16–29*).—This is a part of a review of the first 25 years' work of this station, and summarizes the results of examinations of bone meal, guano, nitrate of soda, Thomas slag and mineral phosphates, Hensel's mineral fertilizers, concentrated cattle manure, peat and feces mixture, town sewage, sludge, mill waste, leached wood ashes, etc.

FIELD CROPS.

Fertilizer experiments upon clovers, A. VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 11 (1896), No. 1, pp. 16–27*).—In coöperative tests at 3 different places phosphoric acid, phosphoric acid and kainit, and phosphoric acid, kainit, and lime were applied to plats of red clover, alfalfa and grass, and red clover and esparcet. Tabulated details are given for crop production, composition of soil, and

[1] See Landw. Jahrb., 1873, p. 107; Ber. Landw. Vers. Stat. Münster, 1878, p. 203.

protein content of the hay, and notes upon the experiments. The season was so favorable for hay production that the effect of the fertilizers was minimized, and they did not give a profit; but superphosphate increased the yield on soils containing 0.173, 0.062, and 0.079 per cent of phosphoric acid, and potash on soils having a potash content of 0.854, 0.628, and 0.18 per cent, while lime increased the yield where the lime content was 0.29 per cent, but did not do so where the content was 1.68 or 0.27 per cent. The author believes that an application of lime will be effective only when the soil is rich in potash.

Soil test with field corn at Dover, W. H. BISHOP (*Delaware Rpt. 1895, pp. 229–232*).—Previous work in this line was published in the Annual Report of the station for 1892 (E. S. R., 5, p. 780).

Five check plats, 1 gypsum plat, and 10 others fertilized with nitrogen, phosphoric acid, and potash alone, and in combinations of 2 and 3, were planted to corn, June 2, following a crop of crimson clover plowed under.

The yields calculated to a full stand are tabulated. The author considers that a crop of pea vines and one of crimson clover plowed under have kept up the fertility of the soil for 6 years; that applications of nitrate of soda in combination with other elements were not profitable in 1894; that the largest crops in 1894 followed applications of potash; that phosphoric acid was second to potash in this regard, and that either applied alone is profitable.

Fertilizer test on sweet corn, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 238, 239*).—Evergreen sweet corn was grown on twentieth-acre plats differently fertilized. The plats receiving potash gave the largest yields, but the author thinks this due to the protective influence of the potash against an unknown disease which seriously affected plants on other plats.

Maize, A. A. BRIGHAM (*Inaug. Diss. Göttingen, 1896, pp. 54*).—After discussing the origin, distribution, variability, and uses of maize, and the methods of culture followed in America, the author considers the relations between the different parts of the plant and the yield of grain in the Longfellow variety. The points considered were weight (fresh and air dry) of the whole plant, of plant without suckers, of the suckers, of leaves, and whole stalk; length of whole stalk, length of each internode, diameter of each node, length of each sheath and of each leaf, maximum breadth of each leaf, length of the ear and weight (air dry), number of kernels on each ear; weight (air dry) of the kernels on each ear, weight of the cob (air dry), and of the butt and husks. The data are tabulated and discussed. Among the conclusions the author states that an increase in the weight of corn is accompanied by an increase in the weight of the plant, number of kernels, length of ear, weight of cob, butt, husks, suckers, and leaves, an increase in the weight of the individual kernels, and likewise in the percentage of grain compared with the weight of stalks.

Comparing the best plants of this variety with those less productive, the author says:

"We likewise find a favorable condition of development of the plant in those parts which have the highest influence on the nourishment and development of the kernels; the kernels increase in number and individual weight, the cob enlarges in order to bear the kernels, the butt and husks increase, the ear-bearing nodes enlarge to be able to bear the ear, the lower nodes thicken and gain thereby in power of resistance and support, the leaf sheaths on the ear-bearing nodes are shortened to make room for the outward pressure of the ear; in short a change takes place in the proportion of straw and grain in favor of the latter.

"If we breed plants in which these distinguishing traits are well developed and which transmit the same to their descendants, which is to be expected from a rational selection, we may in this way improve the yield of grain, and can even increase the total yield."

Cotton, S. M. TRACY (*Mississippi Sta. Rpt. 1895, pp. 6–25*).—This is essentially a reprint of the data in the Annual Report of the station for 1893 (E. S. R., 6, p. 798), with some additional matter.

In 1894 the estimated increase from applications of 35 bu. of cotton seed and 250 lbs. of kainit per acre was 445 lbs. of seed cotton, and from double the amount of fertilizer it was 653 lbs. The increase in 1895 from like applications was 310 and 639 lbs. per acre, respectively. The average yield from drill application of fertilizers has been 58 lbs. per acre more than from broadcast application.

At Lake, in 1894 and 1895, 70 bu. of cotton seed and 400 lbs. of acid phosphate per acre gave most profitable yields. At Holly Springs, in 1894, of 20 plats planted, 15 were manured with 250 lbs. each of kainit, acid phosphate, and cotton-seed meal, alone and in combinations of 2 and 3. The largest and most profitable crops were produced where both acid phosphate and cotton-seed meal were applied.

All applications of fertilizers to black prairie soil have been uniformly unsatisfactory. The author thinks this may be due in part to a too compact subsoil, which may be remedied by growing leguminous crops with strong taproots.

Experiments with oats, J. F. HICKMAN (*Ohio Sta. Bul. 67, pp. 18*).—These experiments are mainly in continuation of work published in Bulletin 57 of the station (E. S. R., 7, p. 27). They include variety tests, methods of seeding, and preparation of the seed bed.

Variety test (pp. 1–14).—Seventy varieties were tested at the station, of which 29 were also tried at the substation. Tabulated data are given of yields of grain and straw for 3 years, and percentage of smut, of yield of grain for 5 years, and of weight per bushel.

The author states that the average per cent of smutted heads in 49 varieties of white oats was 13.69 and in 14 varieties of black oats 17.43. The highest average yield (over 50 bu. per acre) was decidedly in favor of the Seizure group, with a one-sided panicle. The Welcome group is the only one whose average equalled the standard weight.

Methods of seeding and preparation of the seed bed (pp. 15–18).—On 5 of the 14 plats used barnyard manure had been applied for the previous crop, in part as fast as made and in part at the time of planting.

Trials were made with deep and shallow drilling, broadcasting, rolling the land before sowing, and rolling after sowing. Plowing was also compared with surface cultivation with a disc harrow.

"In manuring ground for corn [applying] directly from the stable during mid-winter, and manuring from the barnyard just before plowing . . . left a residual effect, noticeable on the oat crop following, in favor of the [former method] . . . .

"Seeding 1 in. deep gave the highest results in 1895, but the average for a series of years indicates better results from covering about 2 in. deep.

"On our clay soil compacting the ground either before or after seeding has resulted in lower yields.

"The results this year have not shown any appreciable difference between plowing the land and surface cultivation as a preparation for the seed, but a series of experiments shows a marked difference in favor of plowing the land."

Restoring pasture, C. F. CURTISS (*Iowa Sta. Bul. 32, pp. 467–469*).—In the spring of 1893 on tenth-acre plats of blue-grass pasture, on a gravelly soil, a trial was made of sowing clover seed at the rate of 10 qt. per acre, following with a disc harrow, and of applying fine barnyard manure at the rate of 40,000 lbs. per acre. The yields of hay were increased by the two operations at the rate of 1,500 lbs. and 1,700 lbs. per acre, respectively.

In a similar experiment in 1895 on richer soil and better grass land clover and timothy seed, mixed "in equal parts," were sown at the rate of 30 lbs. per acre, followed by 2 workings with a disc and 2 with another harrow; gypsum was applied at the rate of 500 lbs., and liquid manure at the rate of 4,000 lbs. per acre.

The author states that the increased yield was equivalent to 800 lbs. of hay per acre where the seed was sown and 650 lbs. where the liquid manure was applied.

The plat treated with gypsum yielded less than the check plat.

Tests of sorghum varieties, C. L. PENNY (*Delaware Sta. Rpt. 1895, pp. 176–197, charts 8*).—A very careful study was made of 6 varieties of sorghum grown from seed sent out by this Department. Over 1,400 separate stalks were measured in length, weighed in gross and stripped, crushed, and specific gravity and sugar content determined in the juice. Tables show summarized data of crop production, composition, and coëfficient of availability for all varieties; classification by sugar content and purity for the stalks of each variety; and comparison between richer and poorer halves of each variety.

The author believes improvement in sorghum must come not from richer varieties, but from varieties freer from poor stalks. The resistance of the varieties to windstorms is calculated, and charts are given showing graphically the changes in weight of stalks and richness and purity of juice throughout the ripening season.

Graphic methods for calculation of polariscope results and for determination of purity are shown and discussed.

Field experiments with wheat, W. C. LATTA and W. B. ANDERSON (*Indiana Sta. Bul. 61, pp. 57–70*).—This is a continuation of work published in Bulletin 56 of the station (E. S. R.,-7, p. 393).

Test of varieties (p. 58).—Tabulated data give the yields for 9 varieties of wheat with the averages for 2 to 13 years. The authors note the comparatively indifferent yields of new varieties not acclimated and the continued good yield of varieties grown continuously for 5 to 13 years.

Quantity of seed per acre (p. 59).—Amounts varying from 2 to 8 pecks per acre were sown. In 1896 7 pecks gave the highest yield. Six pecks are recommended as sufficient on good land well prepared.

Early and late sowing (p. 60).—Sowing about the middle of September is recommended.

Effect of change of soil (pp. 60, 61).—Four varieties of wheat grown at the station were sent to places in the northern, central, and southern parts of the State and the resulting wheat was returned to the station and grown alongside the same varieties which had been in continuous culture. Only 1 variety, Michigan Amber, produced more from the imported seed. The authors conclude that change of soil may increase the yield in some cases, but not in others.

Early and late harvesting (pp. 62, 63).—Two varieties were cut when in the milk, soft dough. hard dough, ripe, and dead ripe stages. Harvesting when in the hard dough stage gave the largest yield.

Depth of plowing (pp. 63, 64).—Trials were made on 10 tenth-acre plats of plowing 4, 6. and 8 in. deep, and of subsoiling below part of the 6 and 8 inch plowings to depths of 4, 6, and 8 in. The results were inconclusive.

Phosphatic marl on wheat (p. 64).—Phosphatic marl containing 10 to 12 per cent of phosphoric acid was applied on 2 plats at the rate of 220 lbs. per acre and produced no perceptible effect on the yield.

Wheat in alternation with corn with and without manure (pp. 64–66).—Dissolved boneblack, sulphate of ammonia, and muriate of potash were applied on 2 plats, horse manure on 2, and 3 plats received no fertilizer. The author states that the heavier applications of manure and commercial fertilizers returned the larger profits, with only slight difference between them.

Continuous wheat growing with and without manure (pp. 66, 67).—The same combinations of manures as in the previous section, but in different amounts, were used on 7 plats on which wheat was grown continuously. The commercial fertilizers are reported as being used at a loss, while the barnyard manure returned a small profit.

Complete and incomplete fertilizers on wheat (pp. 68–70).—Dissolved boneblack, sulphate of ammonia, and muriate of potash, alone and in combinations of 2 and 3, and horse manure, cattle manure, gypsum, lime, and salt alone, were applied on 12 tenth-acre plats; 5 plats received no fertilizer.

These plats were in a 5-course rotation of corn, oats, wheat, grass, and grass. Except grass, each of the crops was manured, but not with the same amounts. The authors conclude that it is unprofitable to return to the land an amount of plant food equal to that removed by a maximum crop; that muriate of potash (alone), gypsum, and lime acted injuriously; that the use of fresh horse manure on wheat has generally returned a profit, likewise complete commercial fertilizers in some cases; but that incomplete fertilizers, except dissolved boneblack, have not been found profitable.

Winter wheat, C. F. CURTISS (*Iowa Sta. Bul. 32, pp. 461–463*).—The Turkish Red is recommended above all others for the vicinity of the station.

In a comparison of the yields of wheat sown with a press drill and with a common drill the differences were 18 and 10.7 bu. per acre for 1894 and 1895, respectively, in favor of the press drill.

Cultural value, composition, and culture of brewing barley, F. KRANTZ (*Landw. Jahrb., 23 (1896), No. 6, pp. 963–1006*).

Application of fertilizers at different depths for barley and oats, A. VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 11 (1896), No. 1, pp. 1–15*).—Details are given of 7 coöperative experiments with barley and 3 with oats. The fertilizer used on part of the plats in each test was plowed under, on the other plats applied on the surface. Copious rainfall, which made the fertilizers on the surface soluble and distributed them through the soil, made the experiments inconclusive.

Should color of the grains guide in the purchase of barley? (*Landw. Centbl. Posen, 24 (1896), No. 44, p. 247*).

Variety tests of barley, oats, field peas, and rape, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 350–354, 360, 361*).—Reprinted from Bulletin 46 of the station (E. S. R., 8., p. 223).

Fertilizer experiments on beets, E. VON PROSKOWETZ, jr. (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 11 (1896), No. 1, pp. 28–35*).

Culture and preparation of chicory, J. STORME (*Rev. Agron. Louvain, 5 (1896), No. 2, pp. 138–167, figs. 19, chart 1*).

Crimson clover, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 236, 237*).—Tabulated data are given for crops of clover raised on plats differently fertilized. Muriate of potash gave best results.

Egyptain clover and spurry, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 237, 238*).—Both proved failures at the station.

Corn, S. M. TRACY (*Mississippi Sta. Rpt. 1895, pp. 25–40*).—This article contains matter previously published in the Annual Report of the station for 1893 (E. S. R., 6, p. 798) and Bulletin 33 (E. S. R., 7, p. 198), with some additional data.

In 1895 there was no difference in results from applying the Furman compost and one in which the acid phosphate was replaced by kainit.

Score card for dent corn (*Agl. Student, 3 (1896), No. 3, pp. 73, 74*).—The scale of points used in the study of corn varieties in the agricultural department of the Ohio State University is given, with remarks upon essential features.

Corn, C. F. CURTISS (*Iowa Sta. Bul. 32, pp. 465–467*).—Of 8 varieties tested the largest yields were obtained from Nickel Plate, Early Yellow Rose, Stanner Yellow Dent, and Mortgage Lifter.

Corn experiments, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 331–342*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 223).

Cowpeas at Dover, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 232–236*).—Cowpeas of the Clay and Black varieties were planted at different dates from May 18 to July 25

on plats manured with commercial fertilizers in various combinations. The yields are tabulated. The author concludes that the later plantings in June and early July are the most profitable.

Grasses and forage plants, S. M. TRACY (*Mississippi Sta. Rpt. 1895, pp. 41–44*).—This is a republication of matter found in the Annual Report of the station for 1893 (E. S. R., 6, p. 807).

The Jack bean (*Canavalia ensiformis*) has been grown, producing 30 to 40 bu. of beans per acre on a thin soil. Its value as a fodder plant has not yet been determined.

Cornstalks shredded in October and baled in November showed no signs of molding. An analysis (food constituents) is given.

Exotic vs. native fodder plants and grasses, W. TYSON (*Agl. Jour. Cape Colony, 9 (1896), No. 22, pp. 570, 571*).

A useful oat grass, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 9, p. 561, pl. 1*).—Notes are given of an oat grass, *Anisopogon avenaceus*, said to be valuable for pasturage in sterile, stony regions.

Lime and lupines (*Deut. landw. Presse, 23 (1896), Nos. 91, p. 809, figs. 4; 92, p. 816, figs. 6*).—The author concludes that where calcium carbonate is present in the soil to the extent of 0.46 per cent it has an injurious effect on lupines. Phosphate of lime and magnesium carbonate are even worse, 0.5 per cent of the latter preventing development. One per cent of $Ca_3(PO_4)_2$ kills the lupines and 10.5 per cent works injuriously. Calcium sulphate was least injurious of the lime compounds. "The injurious effect which calcium carbonate exercises on the growth of lupines can be prevented either by kainit or potassium nitrate or by both together."

Studies on the stand of plants in good and bad meadows, R. BRAUNGART (*Fühling's landw. Ztg., 45 (1896), No. 4, pp. 132–135*).

Thomas slag and kainit on oats, P. PETERSEN (*Fühling's landw. Ztg., 45 (1896), No. 4, pp. 140, 141*).—The yield of oats on marsh land, plowed in the fall and harrowed in the spring with 268 kg. per hectare of Thomas slag and kainit, costing 18.85 marks ($4.712), produced an increase of 146.82 marks ($36.705); manured with 568 kg. of the foregoing fertilizers, costing 40 marks ($10), the yield was increased by 174.65 marks ($43.662), showing that a rational application of commercial fertilizers under the present unfavorable conditions can in many cases still be made to pay.

Oats, fertilizer test, C. F. CURTISS (*Iowa Sta. Bul. 32, p. 463*).—An application of a combination of muriate of potash, gypsum, lime, salt, and wood ashes, in 2 amounts per acre, failed to show any effect in preventing the oats from lodging.

Varieties of oats, C. F. CURTISS (*Iowa Sta. Bul. 32, pp. 463–465*).—Of 7 varieties under trial the largest yields were given by Golden, Black Russian, and Calgary Gray.

Test of Polygonum cuspidatum and P. sachalinense, E. VON PROSKOWETZ, jr. (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 11 (1896), No. 2, pp. 40, 41*).

Potatoes, variety tests, S. B. GREEN (*Minnesota Sta. Rpt. 1895, pp. 299–307, fig. 1*).—Reprinted from Bulletin 45 of the station (E. S. R., 8, p. 219).

Field root crops, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 356–360*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 223).

Separating sunflower seeds from their heads, C. O. ORMSBEE (*Amer. Agr. (mid. ed.), 1896, Sept. 26, p. 266*).—The apparatus used consists of a wooden wheel 2 in. thick, through which nails are driven. The sunflower heads are held against the projecting nails, which brush off the seeds.

The geographical distribution of tobacco culture and the amount produced, P. DARMSTADTER (*Inaug. Diss. Halle, 1896, pp. 99; abs. in Bot. Centbl., 68 (1896), No. 4, pp. 122, 123*).—The author gives the total production of the world at 916.6 million kg.; of the United States, 240 million kg.; British India, 175 million; Russia, 70 million; Austro-Hungary, 65 million; China, 50 million, and Germany, 35 million.

Seeding to wheat in fall and winter, G. HEUZÉ (*Jour. Agr. Prat., 60 (1896), II, No. 46, pp. 725–727*).

Studies upon seed wheat, A. VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 11 (1896), No. 1, pp. 42–52*).—Tests were made of seed wheat plants grown for several years under different conditions as to thickness of sowing in the field and in pots. The author concludes that other influences, especially fertilizers, affect the crop much more than conditions of seed growth.

Wheat, S. M. TRACY (*Mississippi Sta. Rpt. 1895, pp. 44–46*).—Practically a reprint of matter which appeared in Annual Report of the station for 1893 (E. S. R., 6, p. 806).

Variety tests of wheat, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 342–350*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 222).

Tillage experiments, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 384–389*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 222).

The method and cost of grain production in the provinces of Santa Fé and Cordova (*Mitt. deut. landw. Ges., 11 (1896), Nos. 15, pp. 8; 16, pp. 8; 17, sup. pp. 8*).

Miscellaneous crops, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 46–48*).—Largely matter which appeared in Annual Report of the station for 1893 (E. S. R., 6, p. 807).

Ramie planted in 1890 has made fair crops since 1891. Jute has also been grown successfully.

Sunn hemp (*Crotalaria juncea*) has proved of no value by reason of its coarse fiber, since true hemp can be grown so cheaply at the station.

Cañaigre has been grown at the station for 2 years with unsatisfactory results.

Silos and silage, D. O. NOURSE (*Virginia Sta. Bul. 53, pp. 75–80*).—This is a popular article on the subject, treating of the history of the system, a simple excavation in the ground used as a silo, location of silo, size and form of silos, varieties of corn and amount of seed, cutting and storing, capacity of silos, silos on the station farm, and expense of filling. While an unwalled pit will preserve the fodder successfully, the author considers a rectangular wooden silo best.

Drying grains (*Deut. landw. Presse, 23 (1896), No. 97, pp. 859, 860*).

Experiment in rotation of crops, W. H. BISHOP (*Delaware Sta. Rpt. 1895, pp. 239, 240*).—A report of progress is made on a test of the effect of a leguminous crop coming between 2 grain crops.

Cross rotation experiments, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 369–372*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 223).

HORTICULTURE.

Experiments with cauliflower in the greenhouse, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 124–127*).—On each of 2 similar greenhouse benches 32 cauliflower plants were set 12 in. apart in rows 18 in. apart. One bench was given surface watering and the other received the same amount of water through a row of 3-inch horseshoe tile placed on the bottom of the bench. The weight of each plant at the time of harvesting and of the heads as ready for market are given. The subirrigation bench produced 29 heads averaging 12.7 oz. and the surface watered bench 21 heads averaging 10.6 oz.

One bench of the greenhouse was planted with 64 plants 12 in. apart each way and divided into 4 equal plats for a fertilizer experiment. One plat received no fertilizer and the others 4 oz. of nitrate of soda, 8 oz. of muriate of potash, and 8 oz. of acid phosphate, respectively, the fertilizers being applied in 4 equal portions. The weight of each

plant and head are given. The number and average weight of heads on each plat are shown in the following table:

Effect of different fertilizers on cauliflower.

Fertilizer.	Number of heads.	Average weight.
		Ounces.
None	2	10.75
Nitrate of soda	9	10.56
Acid phosphate	8	11.06
Muriate of potash	10	11.20

Tomatoes, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 127–134*).—To ascertain how much nitrate of soda can safely be applied to plants in setting out, solutions of different strength were used to water the plants. One group of plants received 3.5 grains of nitrate per plant, in one-half pint of water poured directly about the roots, and the plants of the other groups received 7, 14, and 21 grains, respectively. One group served as a check, the plants being given water only. The plants were set on June 10, and on June 25 all of those watered with the strongest solution were dead, only 1 plant of each of the next two groups was living, 7 were alive in the group receiving 3.5 grains, and all in good condition in the check group. The author concludes that "only a small amount of nitrate of soda can be applied directly to the roots of tomato plants when transplanting." Quite heavy applications can be made without injury to the plants if applied to the surface of the ground or worked into the soil.

Notes are given upon 51 varieties of tomatoes grown at the station.

Apple culture, L. F. KINNEY (*Rhode Island Sta. Bul. 37, pp. 31–45, figs. 8*).—This bulletin consists mainly of popular directions for the cultivation and care of established orchards. The author urges the necessity of fertilizing apple trees as much and as regularly as the other cultivated crops. He recommends crimson clover as a nitrogen gatherer, but finds that it can be depended on only as a summer or catch crop, as it frequently winter kills in the State. Directions are given for culture of the plant in orchards and figures illustrating its habit of growth.

The need of a good supply of water when the apples are maturing is emphasized, and cultivation and mulching are recommended as moisture conservers.

To show the need for the apple of light and air, two branches of equal size were cut from each of 10 trees in different parts of an orchard in which the trees were planted too close. "The limbs selected were about 1 in. in diameter, and in each case one was taken that was fully exposed to sunlight and the other where partially shaded. When the limbs were taken to the laboratory, where the buds were counted, the

action of the sunlight in promoting the formation of fruit buds was apparent." In every case but one there were more buds upon the branch exposed to the light, and the averages were: Limbs in sunlight, 182 clusters of flower buds; limbs in partial shade, 136 clusters. By skillfully shortening in and thinning the branches of flat-topped trees in crowded orchards their tops can be restored to a more nearly conical form, light and air more freely admitted, and bearing capacity of the trees often greatly increased.

The author considers spraying essential to success in apple growing, and gives a formula for Bordeaux mixture with Paris green which has worked well at the station.

The apple maggot is very injurious to apples in the State, appears to be increasing rapidly in numbers, attacks all varieties, and renders worthless the fruit on thousands of trees of the subacid varieties. From beneath 8 trees in different localities soil was collected, sifted, and examined for pupæ of this maggot, and the numbers found in areas 6 in. square and 1 in. in depth varied from 0 to 6. The fruit was worthless in all cases where 5 or 6 pupæ were found and only slightly wormy where 1 pupa was found. It was estimated that 12,500 pupæ were secreted in the soil beneath the tree of Yellow Bellflower where 5 pupæ were found in the area examined. The author believes that poultry confined beneath the trees would materially lessen the number of pupæ.

Varieties of apples, T. J. BURRILL and G. W. MCCLUER (*Illinois Sta. Bul. 45, pp. 297–348*).—A brief history is given of the orchard of the university from 1869; remarks upon pests, soil treatment, life of trees, and identity of varieties; descriptions of 18 varieties which have given most promise of usefulness and of 550 varieties (including synonyms) which have fruited on the station farm, and a list of 304 trees which were planted but did not live to bear fruit.

The 18 selected varieties, arranged according to season, are William Prince, Red Stripe, Hicks, Cole Quince, Large Yellow Siberian Crab, Jefferis, Sharp, Utter, Jonathan of Buler [?], Sweet Bellflower of Wyandotte County [?], McLellan, Higby Sweet, Mansfield Russet, Westfield, Coon Red, Ned, Indiana Favorite, and Royal Limbertwig.

Preliminary investigation of the effect of the overflow of salt water upon the health and fruitfulness of peach trees, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 150–152*).—High tides have at different times overflowed many peach orchards in the State, and it was claimed that such orchards were fruitful when the others in the State were barren, and that they were free from yellows. The author investigated the subject and found it to be a fact "that orchards in the vicinity of large ponds and streams of water were the ones producing a crop of peaches and in very many instances the land had been overflowed by salt water," but he thinks this due to the protective presence of the water during a general freeze which occurred at the time of one overflow and which injured the trees not thus protected.

The trees exposed to the action of the salt water were vigorous and healthy and the foliage of a deeper green color than that of trees on higher land, though in one instance the fruit appeared decidedly lighter in color. "There was no indication that such trees were any more exempt from the yellows."

Some advances in breeding fruits and shrubs, J. L. BUDD and N. E. HANSEN (*Iowa Sta. Bul. 32, pp. 486–498, figs. 4*).—This is a progress report upon experiments made at the station in the cross fertilization of roses, gooseberries, strawberries, grapes, plums, pears, and apples. In most cases flowers and fruits have not yet been produced, so that final results can not be given, but apparently successful crossing has been accomplished with the production of healthy plants.

The work upon roses is in continuation of that recorded in Bulletin 22 of the station (E. S. R., 5, p. 985), the crosses being the best garden roses upon the Russian *Rosa rugosa*. The pollenization was made in 1892, and during 1895 the resulting plants "have made a rampant growth which has been unfavorable for the blossoming of such young plants. As a rule, the hybrids showing most variation from the *Rosa rugosa* mother have not bloomed, while those following more nearly the mother in leaf and habit have given more bloom."

Descriptions are given of 2 seedlings resulting from fertilization with pollen of General Jacquiminot, one producing a larger, more perfectly double flower than the General Jacquiminot and the other having a very profuse and long-continued blooming habit, and blossoms of vivid color and great fragrance. Figures illustrate these seedlings and the parents.

Descriptions are given of 11 plum hybrids which "have given some evidence of value."

The work upon apples is in continuation of that reported in Bulletin 14 of the station (E. S. R., 3, p. 223). The only seedling that fruited was from "Silken Leaf crossed with Osceola pollen, and it confirms the belief expressed in 1891, viz, that the hardiness follows largely the mother variety, and that the fruit most frequently is modified by the male parent. The tree appears to be a true iron-clad, and the fruit closely resembles the Osceola in size, shape, color, quality, and season."

Suggestions for the planting of shrubbery, L. H. BAILEY (*New York Cornell Sta. Bul. 121, pp. 441–446, figs. 20*).—A discussion in popular form of landscape gardening "for the betterment of home grounds in rural communities." The author emphasizes the idea that each yard should be a picture with a distinct individuality, and treats of the proper handling of foliage masses and the greensward for the securing and retaining of natural effects. Some specific examples of artistic planting are given, with diagrams and figures.

Variety tests of beans, W. M. HAYS (*Minnesota Sta. Rpt. 1895, p. 355*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 231).

Growing castor beans (*Florida Agriculturist, 24 (1896), No. 1, p. 6*).

Mushroom growing, G. C. WATSON (*Amer. Florist, 12 (1896), No. 448, p. 515, fig. 1*).

Notes on mushrooms, E. ROZE (*Bul. Soc. Mycol. France, 12 (1896), No. 4, pp. 143–148*).—Directions are given for distinguishing between edible and poisonous mushrooms.

Tomatoes, S. B. GREEN (*Minnesota Sta. Rpt. 1895, pp. 313–320, figs. 2*).—Reprinted from Bulletin 45 of the station (E. S. R., 8, p. 225).

Tomatoes under glass, W. E. BRITTON (*Garden and Forest, 9 (1896), No. 462, pp. 526, 527*).

Care of frames in winter, W. N. CRAIG (*Garden and Forest, 9 (1896), No. 460, pp. 506–508*).

Apples of Tennessee origin, R. L. WATTS (*Tennessee Sta. Bul., Vol. IX, No. 1, pp. 34, figs. 20*).—By means of letters and circulars sent to farmers and fruit growers throughout the State the location has been ascertained of about 100 seedling apple trees of more or less merit. Fruit from many of these trees was studied, described, compared with well-known varieties, and photographed at the station. Twenty-seven varieties considered valuable, at least in the vicinities of their origin, are described, and 20 of them figured in the bulletin. Extended notes are given upon the history of the Ben Davis and Paragon varieties.

Varieties of apples for Delaware, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 154–158*).—Some remarks are made upon the necessity for careful testing of varieties for culture in the State, and a list given of 180 varieties growing from scions in an orchard under station control.

Pineapple, analysis and manure, J. J. BOWREY (*Bul. Bot. Dept. Jamaica, n. ser., 3 (1896), No. 10, p. 236*).—Analysis of the ash gave potash 49.42, magnesia 8.80, calcium carbonate 12.15, and phosphoric acid 4.08 per cent. Suggestions are given for the proper manuring of this crop.

Pineapple growing under glass, N. BUTTERBACH (*Amer. Gard., 17 (1896), No. 105, pp. 817–819, pl. 1*).

Culture of the prune, J. E. GORDON (*California Fruit Grower, 20 (1896), No. 1, p. 1*).

French prunes, methods of their preparation, E. CONNER (*Gard. Chron., ser. 3, 20 (1896), No. 522, p. 780*).

Hints on starting an orchard, W. W. STEVENS (*Amer. Gard., 17 (1896), No. 105, pp. 823, 824*).

Transplanting large trees, E. A. LONG (*Amer. Gard., 17 (1896), No. 105, pp. 819, 820, fig. 1*).

Raspberries, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 149, 150*).—Notes are given on 10 varieties of raspberries, 1 variety of blackberry, and the Japanese wineberry.

Strawberries, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 140–149*).—Notes are given upon 93 varieties grown at the station, with an indication of the amount each suffered from blight. The 10 varieties selected as best for home use are Beverly, Bomba, Brandywine, Bubach, Gandy, Greenville, Harmon, Michel Early, Shuster, and Smelzer; for market: Bubach, Brandywine, Greenville, Harmon, Michel Early, Mrs. Cleveland, Muskingum, Pearl, and Phillips.

Small fruits, variety tests, S. B. GREEN (*Minnesota Sta. Rpt. 1895, pp. 321–325, figs. 2*).—Reprinted from Bulletin 45 of the station (E. S. R., 8, p. 231).

Packing and handling grapes (*Rural New Yorker, 55 (1896), No. 2436, p. 355*).

Fifteenth congress for wine culture at Heilbronn, September 12–16, 1896 (*Chem. Ztg., 20 (1896), No. 77, pp. 743–745*).—Questions relating to manuring, injurious insects and fungi, and fermentation were discussed.

Grapes, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 134–139*).—Notes are given upon 53 varieties grown at the station.

Choice of grape stocks, L. RAVAZ (*Rev. Vit., 1895; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 5, pp. 236, 237*).—Discusses and classifies American grapevines according to their resistance to phylloxera.

Chestnut culture for fruit, W. A. BUCKHOUT (*Pennsylvania Sta. Bul. 36, pp. 13, pls. 3*).—A popular bulletin containing general remarks upon the chestnut industry, the chestnut tree and its habits, and native and foreign varieties; and directions for selection of location for orchards, for sprouting seeds and transplanting young plants, grafting, and harvesting.

The rose, its culture and care, R. BETTEN (*Die Rose, ihre Anzucht und Pflege. Frankfurt a. O.: Trowitzsch und Sohn, 1896, pp. 222, figs. 138*).—A practical handbook of rose growing.

Our window gardens, G. W. CARVER (*Iowa Sta. Bul. 32, pp. 516–525, figs. 2*).—Detailed descriptions are given for culture of the calla lily, freesias, and white-flowered tobacco (*Nicotiana affinis*); directions for rooting cuttings by different methods, for raising plants from seed, and for watering, and notes upon diseases.

Horticultural work at Mississippi Station (*Mississippi Sta. Rpt. 1895, pp. 62–69*).—Brief notes without detailed results are given upon 10 varieties of apples, 16 of pears, and 3 of Japanese plums grown at the station. The methods of the station in the culture of grapes and strawberries are outlined and lists given of varieties succeeding best. Mention is also made of unsuccessful attempts to raise Japanese persimmons, goumi, currants, gooseberries, raspberries, and blackberries.

An outline of a course in horticulture, W. M. MUNSON (*Garden and Forest, 10 (1897), No. 463, pp. 2, 3*).—An outline is given of a course of horticulture that is based upon the Cornell course.

Horticulture in the five divisions of the world, C. BALTET (*L'Horticulture dans les cinq parties du monde. Troyer: Lacroix, pp. 776*).—Reviewed in *Rev. Sci., ser. 4, 6 (1896), No. 25, p. 785.*

SEEDS—WEEDS.

Germination of hulled and unhulled timothy seed, W. H. BISHOP (*Delaware Sta. Rpt. 1895, p. 240*).—Germinator and plat tests were made of timothy seed to ascertain the effect of the removal of the hulls from the grain. In the germination apparatus the original sample gave 63 per cent vitality, while the hulled seed gave 56 and the unhulled 72 per cent. Four samples of each were tested. In the plat trials no difference could be detected either in the germination or subsequent crop. The slight depreciation in the germination of the hulled seed is thought to be due to injury to the seed during threshing.

Copper sulphate and germination, W. H. EVANS (*U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 10, pp. 24*).—A summary is given of numerous reports on the effect of solutions of copper sulphate on various kinds of seed treated for the prevention of fungus diseases. A detailed report is also given of experiments conducted by the author in which is shown the effect of different strengths of copper sulphate solution on the germination of oats. Soaking seed for more than 15 minutes in solutions of greater strength than 1 per cent was found to retard and destroy germination to a considerable degree. Experiments tended to show that previous soaking of seeds for a short time in water prior to treating them with the fungicide would prevent much of the injury arising from the use of even the stronger solutions.

Effect of bisulphid of carbon on the vitality of seed and plants, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 152, 153*).—The effect of

treating wheat with carbon bisulphid before planting was tested and the germination in 2 lots of 1,000 seed each was not influenced to any practical extent.

Strawberry plants were subjected to the fumes for 1 hour before planting and they suffered considerable injury. Plants may be treated while growing without injury.

Experiments to destroy horse nettle, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 153, 154*).—Experiments were conducted to destroy *Solanum carolinense*, locally known as Sodom apple, sulphuric acid and kerosene being employed. The results showed that they were efficient only so far as they penetrated the roots, which was but a few inches, the plants readily sprouting from below. Only frequent culture and digging out the roots proved certain means of eradication.

A new germinating apparatus, H. F. JONKMAN (*Bot. Centbl., 68 (1896), No. 8, pp. 254–256, fig. 1*).

Weeds in our fields, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 373–383, pls. 2*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 234).

DISEASES OF PLANTS.

Ammoniacal solutions of copper carbonate, C. L. PENNY (*Delaware Sta. Rpt. 1895, pp. 206, 207*).—The author calls attention to the economy of using dilute solutions of ammonia in the preparation of ammoniacal copper carbonate solutions. Dilute ammonia will dissolve more copper carbonate than the stronger solutions. In general practice in preparing this fungicide the author recommends diluting the ammonia nine-fold before applying it to the copper carbonate, this solution to be still further diluted one hundredfold before using.

Rust in wheat conference, D. MCALPINE and W. LOWRIE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 438–443*).—At the meeting of this conference held in Melbourne in May, 1896, the committee made a final report in which the general work attempted was outlined. The opposition of the millers to rust-resistant wheats is shown to be inapplicable to the recommendations of the conference since the varieties suggested as resistant are not to be classified with the maccaroni wheats, but are of the same grade as the best Minnesota and Hungarian varieties of bread wheats.

The work of the nomenclature committee in determining and classifying varieties of wheat into rust resistant, rust escaping, and rust liable is commended, and it is recommended that it be continued.

Although no effective means can be advanced for preventing rust in wheat, yet the risk from loss may be lessened by following as far as possible these suggestions:

Early ripening varieties should be cultivated. Where late varieties are used early sowing should be adopted, and the grain should be

sown thinly, with due regard to the habit of tillering and local conditions of climate and soils. Rust-resistant and rust-escaping varieties should be grown more extensively. When sowings are unavoidably late, early ripening varieties should be sown and phosphatic fertilizers used to hasten the maturity of the plant. The sowing of varieties especially liable to rust should be abandoned, and where new varieties are introduced the farmer is advised to sow them only on a small scale to test their adaptability rather than risk the whole harvest.

The conference gave the following general conclusions:

"It is of opinion that there is no possible treatment of the seed that will protect the plants growing from it from the attacks of rust. Furthermore, that the notion that rust-shriveled seed can be sown with as good results as plump seed is erroneous. Of the many practical details which have been demonstrated experimentally as calculated to diminish the prevalence of rust the conference emphatically recommends the following:

"That seed wheat be allowed to ripen fully, and be carefully stripped or threshed.

"That seed wheat be graded, and the larger and heavier grains selected for seed.

"That the utmost care should be adopted to insure that the varieties of wheat selected for seed be pure and true to name."

A leaf blight of the tomato, F. D. CHESTER (*Delaware Sta. Rpt. 1895, p. 123, figs. 2*).—The author figures and briefly describes a leaf blight of tomato which was first observed during the summer of 1894. The fungus spores are said to be the same size as those described by Saccardo from Argentina under *Septoria lycopersici*. Its identity is not affirmed.

Blight affecting the body of pear and apple trees, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 158, 159*).—Brief notes are given of a blight of apple and pear trees, the diseased trunks of which gave every appearance of being attacked by the common pear blight (*Micrococcus amylovorus*). Thorough washing of the diseased portions of the trees with Bordeaux mixture seemed beneficial in arresting the progress of the disease.

Investigations on the sulphuring of hops, J. BEHERNS (*Wochenschr. Brauerei, 1896, pp. 946–948*).

The diseases of sugar cane, J. RAY (*Bul. Soc. Mycol. France, 12 (1896), No. 4, pp. 139–143*).—A résumé is given of some of the more important publications relating to sugar cane diseases.

Notes on sugar cane diseases, F. A. F. C. WENT (*Ann. Bot., 10 (1896), pp. 583–600, pl. 1*).—Notes are given of the red smut (*Colletotrichum falcatum*) and the pineapple disease (*Thielaviopsis ethaceticus*). Both fungi are saprophytic but are apparently wound parasites producing the two diseases. The author dissents from the opinion of Massee relating to *Trichosphæri sacchari* and *Melanconium* sp. The latter is said never to be found on other than dead canes.

Smut in wheat, W. M. HAYS (*Minnesota Sta. Rpt. 1895, pp. 362–368*).—Reprinted from Bulletin 46 of the station (E. S. R., 8, p. 237).

Strawberry rust (*Garden and Forest, 9 (1896), No. 462, p. 530*).—A brief note is given of the successful use of borax lye as a spray for preventing strawberry rust. One can of the lye was used in 40 gal. of water. The sprayed plants kept bearing for 10 days after the unsprayed ones had ceased.

Report of the interdepartmental commission on black rot at the Bordeaux Congress, F. VASSILLIÈRE (*Prog. Agr. et Vit., 26 (1896), No. 50, pp. 655–667*).—The report shows the efficiency of Bordeaux mixture in controlling black rot if properly applied.

Results obtained by the Rassiguier treatment of vine chlorosis, J. M. GUILLON (*Prog. Agr. et Vit., 26 (1896), No. 48, pp. 606–608*).—The author reports on his inspection of numerous vineyards where this treatment had been successfully employed against chlorosis.

Winter treatment of sooty mold of grape, DEGRULLY (*Prog. Agr. et Vit., 26 (1896), No. 48, pp. 597–599*).—Winter treatment is said to be efficient as a preventive treatment.

Mildew on roses, J. N. MAY (*Amer. Florist, 12 (1896), No. 448, p. 517*).—Sulphur mixed with linseed oil and painted on flow pipes, using only enough to give a perceptible odor of the sulphur in the house, is recommended.

On the injury to woodwork by Merulius lacrymans, P. DUMÉE (*Bul. Soc. Mycol. France, 12 (1896), No. 4, pp. 159–161*).

Destruction of Heterodera schachtii, WILLOT (*Compt. Rend., 123 (1896), No. 23, pp. 1019, 1020*).

On the prevention of beet nematodes, DÖRING (*Der Landwirt., 32 (1896), No 59, p. 349*).

Treatment for potato diseases, S. B. GREEN (*Minnesota Sta. Rpt. 1895, pp. 307–312, figs. 2*).—Reprinted from Bulletin 45 of the station (E. S. R., 8, p. 239).

Experiments in spraying, F. D. CHESTER (*Delaware Sta. Rpt. 1895, pp. 121–123*).—A brief report is given of experiments conducted in 1894 for the prevention of apple scab and peach blight and rot. Owing to unusual conditions resulting in the almost complete failure of the fruit crops the work was discontinued before the end of the season.

Spraying apparatus, S. B. GREEN (*Minnesota Sta. Rpt. 1895, pp. 326–328, figs. 2*).—Reprinted from Bulletin 45 of the station (E. S. R., 8, p. 240).

ENTOMOLOGY.

The chinch bug, F. M. WEBSTER (*Ohio Sta. Bul. 69, pp. 59–80, pls. 3*).—The author has compiled and reviewed some of the more important literature relating to the life history and distribution of the chinch bug (*Blissus leucopterus*), and he gives the results of his investigations on its suppression.

The use of fungus parasites depends on meteorological conditions which are not always present, a serious drought greatly interfering with the efficiency of the method. It is preventive rather than remedial, and so far as known can not be depended upon when a serious outbreak is imminent.

Where the chinch bug has appeared, its further migration may be prevented by the use of kerosene emulsion. Ditching in front of their advance, plowing, harrowing, and rolling the ground will destroy many of the insects. Old grass leaves and rubbish in winter should be burned in order to destroy the hibernating adults.

The San José scale, L. O. HOWARD and C. L. MARLATT (*U. S. Dept. Agr., Division of Entomology Bul. 3, n. ser., pp. 80, pls. 2, figs. 8*).—This bulletin records the history of *Aspidiotus perniciosus*, its present status, its life history and habits, its parasites and other natural enemies,

and remedies and preventives that may be used against it, together with an account of various experiments with insecticides, a general summary of treatment, a discussion of quarantine, and an appended bibliography of the species.

It is believed to have come either from Australia, some part of eastern Asia, or some of the Pacific islands. The history of its introduction to the eastern United States is briefly treated and a summary is given by States of its introduction and present condition. The San José scale is now found in 14 States east of the Rocky Mountains, and in at least 12 nurseries, from several of which it has been sent out on trees for 7 years, thus affording a wide distribution. The effect of climate on its spread is discussed and a map of life zones in the United States is given showing that the present distribution of the scale is limited to the Upper and Lower Austral regions.

In the latitude of Washington, District of Columbia, occur 4 annual generations of 30 to 40 days each, with probably a fifth generation. Careful experiments to ascertain the fecundity of the species revealed the estimated number of 3,216,080,400 descendants from a single female in one year. For the eastern United States the following recommendations are made: Promptly destroy affected stock in case of recent or slight attack, while in older cases of wide extent cut back the trees affected and treat with winter soap wash, always using the utmost care to prevent introduction of infected trees or cuttings. Strong whale-oil soap washes kill the insects with no injurious effect upon the foliage of the trees. Prompt action of State legislatures in passing quarantine measures and enforcing insecticide work is urged.

Insects injurious to the seed and root of Indian corn, S. A. FORBES (*Illinois Sta. Bul. 44, pp. 209–296, figs. 61*).—This bulletin is an abstract of the more economic parts of a previous report.[1] Corn insects now recognized as being to some extent injurious number 214 species, of which 18 infest the seed, 27 the root and subterranean part of the stalk, 76 the stalk above ground, 118 the leaf, 19 the tassel and silk, 42 the ear in the field, 2 the stacked fodder, and 24 the stored grain either whole or ground. The injury caused by many of these is so slight as to be of but little economic importance.

The general indications of injury to seed and roots are described and a synopsis given by which to recognize the cause of the injury. In the synopsis the primary grouping is into (1) injuries to the seed in the earth and (2) injuries to the roots.

The chief injuries to seed in the earth are due (1) to attacks of ants, (2) small beetles, the principal ones being *Agonoderus pallipes*, *Aphodius granarius*, and *Clivina impressifrons*, (3) footless maggots, the larvæ of the seed corn maggot (*Phorbia fuscipes*) and of the black headed grass maggot (*Sciara* sp.) and (4) injuries by 6-legged larvæ the principal of which are the pale striped flea beetle (*Systena tæniata*), the banded ips (*Ips fasciatus*), and various wireworms.

[1] Rpt. Illinois State Entomologist, 7 (1895).

The principal injuries to the roots are caused by the corn root aphis (*Aphis maidiradicis*), the grass root louse (*Schizoneura panicola*), white grubs (*Lachnosterna* and *Cyclocephala* spp.), prionus grubs (*Prionus imbricornis* and *P. laticollis*), Southern corn root worm (*Diabrotica 12-punctata*), Northern corn root worm (*D. longicornis*), and wireworms. The life histories, natural enemies, and preventives and remedial measures to be observed against these several insects are given in considerable detail.

Extensive studies are reported on the corn root aphis, white grubs, the Southern corn root worm, and the Northern corn root worm, these insects having been especially investigated by the author. For the economic procedure against the root aphis the following recommendations are given:

"Our present knowledge of effective economic procedure for the corn root aphis may be summarized in the form of the following recommendations: (1) That the fertility of the ground should be maintained as a general safeguard, and that cultivation should be so managed, especially that of the lower parts of the field, as to prevent so far as practicable the seeding of pigeon grass and smartweed among the corn; (2) that infested fields should be plowed deeply and thoroughly harrowed late in fall or during some suitable early winter interval; and (3) that a somewhat rapid rotation of crops should be systematically followed, corn usually being allowed to grow on the same ground but 2 years in succession. While some work remains to be done with reference to the precise value of these methods in practical application, there is no longer any doubt of their substantial usefulness, at least as a means of holding in check the injuries of the corn root aphis."

Direct remedies against the white grubs are given, but their economic use seems rather improbable. Preventive measures by means of fungus parasites, the value of which is not fully established, are considered worthy further study.

The life history of the Southern corn root worm is so little known that preventive measures can not be given. It seems to be more liable to attack sweet corn, and the proximity of cucurbits and the other more common food plants of the beetle may account for its presence. For the Northern corn root worm by rapid rotation and maintaining a high degree of fertility the plant is able to withstand minor injuries with relatively little loss.

Report of the entomologist, M. H. BECKWITH (*Delaware Sta. Rpt. 1895, pp. 160–175, figs. 5*).—Notes are given of the San José scale and other scale insects in Delaware, the imported elm leaf beetle, the use of carbon bisulphid on cucurbits and for granary insects, arsenites for the curculios and blister beetles, and poisoned baits for cutworms.

The presence of the San José scale in Delaware was first noticed in February, 1895, and it has since been observed in different sections infesting pear, peach, plum, and crab apple trees. The life history and means for the destruction of the insect are given in considerable detail. Brief notes are given on additional species of scale insects which have been observed within the State, as follows: Oyster shell bark louse, scurvy bark louse, rose scale, currant scale, and plum scale.

Illustrated notes are given of the imported elm leaf beetle (*Galeruca xanthomelæna*), and spraying the trees with London purple or Paris green, 1 lb. to 160 gal. water, to which 1 gal. kerosene emulsion may be added, is recommended as the best means for combating this pest. There are two or more broods each year, and spraying must be regulated accordingly.

A report is given of the successful use of carbon bisulphid for ridding cucurbits and cauliflower of plant lice and for the destruction of insects in stored grain.

Effectual experiments are reported on the use of arsenites for destroying blister beetles and curculio. Cage experiments were conducted with baits impregnated with arsenite of soda, arsenite of lead, London purple, Paris green, Fowler's solution, sulphate of strychnia, and white hellebore for the destruction of cutworms. All were effectual except the last two. When applied to field tests it appeared that there was little value in the use of poisoned baits for destroying the cutworms. Where such means are employed it is advised that the baits be used prior to planting the corn on other crops.

Entomological work for 1895, H. OSBORN and C. W. MALLY (*Iowa Sta. Bul. 32, pp. 361–407, pl. 1, figs. 11*).

Synopsis.—Notes are given on the chinch bug, four-spotted pea weevil, the early stages of the imbricated snout beetle, the ground cherry seed moth, and insects occurring in water tanks and reservoirs.

The authors give charts of the distribution of the chinch bug (*Blissus leucopterus*) throughout the State and the more general facts relative to the life history and habits of the insect. Various remedies and preventive measures are suggested for keeping it in check, and numerous insects resembling the chinch bug are figured and briefly described. The control measures suggested consist of burning during hibernation and the arrangement of crops with reference to catch crops in infested fields; early cutting with burning or plowing of stubble; maintenance of barriers between wheat, barley, or rye and oats or corn, and the use of fungus parasites where possible.

During the year an extensive experiment was conducted with the white fungus disease of the chinch bug, in which 33 per cent of the cases reported were considered highly successful. By earlier and more complete distribution it is thought that the fungus may be made effective in a large number of cases.

The four-spotted pea weevil (*Bruchus quadri-maculatus*) is figured and described, the life history of the insect being given in considerable detail. Experiments were conducted in treating seed with carbon bisulphid for the destruction of the insect and to observe any possible effect on the germination of the seed. The contained larvæ, pupæ, and newly formed adults were not all destroyed by the treatment, and to be most effective there should be 2 or 3 applications about 3 or 4 weeks

apart. The germinating power of the seed was not affected in any perceptible degree by the fumes of the carbon bisulphid.

Experiments were conducted to ascertain whether the weevil can live on other seeds than those of peas and beans, and it was found that the insects did not live on any other seed than those above mentioned.

The authors have added many facts of importance to the life history of the imbricated snout beetle (*Epicærus imbricatus*). Although this insect has been known to be economically important since 1863, but little is known of its early stages except a record of its egg laying. Attempts were made to breed the beetle on the strawberry plant, and while not fully successful in tracing the life history the partial development of the larvæ was ascertained. The fragmentary results obtained show that the eggs are deposited in dry and rolled leaves of the food plants of the adult, and that the larvæ immediately enter the ground to feed upon the roots. This would indicate what measures of control must be adopted against this insect.

Illustrated notes are given on the ground cherry seed moth (*Gelechia* sp.). Out of 130 berries containing pupæ but 4 specimens of moths were secured. This low percentage of adults was due to the fact that a large percentage of the pupæ were destroyed by a fungus similar to Sporotrichum, and the remainder were attacked by a hymenopterous parasite. The insect under consideration closely resembles *Gelechia quercifoliella*, but is said to be quite distinct from it. Apparently the most effective remedy for this species would be the destruction of the larvæ or pupæ during the autumn. Infested berries should be gathered and disposed of. The fungus and parasite already mentioned have proved sufficient to keep it in check.

In September, 1895, a weevil (*Baris confinis*) was found working extensively in the root stalks and base of the large branches of cosmos, causing destruction of the plants. Specimens were collected and kept under observation in order to ascertain what was possible relative to the life history of the insect, and illustrated descriptions are given of the larvæ, pupæ, and adults. Collecting and burning the old root stalks and stems of the cosmos early in autumn is the most effective treatment so far as our present knowledge of the species is concerned.

Inquiries concerning the occurrence of an insect in water tanks and reservoirs led to an investigation of this subject, and it was found that large numbers of *Chironomus* sp. were present in the water supply of several places in Iowa. The larvæ and adults are figured and described, and the following suggestions are offered for their exclusion:

"Where practicable [the adults] may be kept out by the use of ordinary mosquito netting or wire gauze. Where this is impracticable the providing of an inlet to distributing pipes that will draw water from a few inches above the bottom of the reservoir, which might further be protected by a fine screen, will, it is believed, avoid the distribution of the worms in the mains."

Entomological work (*Mississippi Sta. Rpt. 1895, pp. 69–78*).—Among the subjects which received special attention during the past year were

the mechanical mixing of kerosene and water, insects injurious to corn, a new elm beetle, preventives for the horn fly and for mosquitos, treatment for peach rot, and work in making a collection of the insects of the State.

In experiments regarding the effect of mechanical mixing of kerosene and water it is found that the proportion of 2 parts of kerosene to 10 of water is needed for thorough work with most caterpillars, while 1:10 will kill many of the young. For most plant lice 2:10 is needed for thorough work. The results of experiments regarding the effects of kerosene on the foliage of various plants showed that most of them will stand a strength of 3:10 without injury. It is observed that in mechanical mixtures more kerosene is needed than where emulsions are made, but the cost is no greater than the soap required to make the emulsion, and the insecticidal value is fully equal to that of the latter.

Brief notes are given on a new corn insect, which has already been described in Bulletin 36 of the station (E. S. R., 7, p. 878).

A report is given of a serious elm pest which proves to be *Monocesta coryli*, and spraying the trees with Paris green is recommended for its destruction. This beetle, the author suggests, should be known as the "greater elm leaf beetle," to distinguish it from the smaller "imported elm leaf beetle."

Kerosene is recommended as a remedy for the prevention of attacks of the horn fly on cattle, and to prevent the breeding of mosquitoes in water tanks.

The station insect collection received numerous additions during the year.

Experiments were conducted with Bordeaux mixture for the prevention of peach rot during 1894 and 1895. The experiments in 1894 were terminated by heavy frost killing all the fruit buds early in the season; and those in 1895, although beneficial in some cases, are not considered conclusive, and must be continued before their real value can be determined.

Some destructive insects, F. M. WEBSTER (*Ohio Sta. Bul. 68, pp. 19–58, pls. 4*).—Notes are given on some particularly destructive insects of Ohio, spraying with arsenites *vs.* bees, and the carnivorous habits of slugs.

The following insects are popularly described, figured, and remedies suggested: The cankerworm (*Anisopteryx vernata*), the fruit bark beetle (*Scolytus rugulosus*), the ring-legged tree bug (*Brochymena annulata*), the clover leaf weevil (*Phytonomus punctatus*), the clover root borer (*Hylastes trifolii*), the strawberry sawfly (*Harpiphorus maculatus*), the harlequin cabbage bug (*Murgantia histrionica*), the squash plant louse (*Siphonophora cucurbitæ*), the western corn root worm (*Diabrotica longicornis*), white ants (*Termes flavipes*), the hostile leaf hopper (*Deltocephalus inimicus*), webworms (*Crambus zeellus*, *C. laqueatellus*, *C. interminellus*, *C. mutabilis*, *C. luteolellus*), and the powder post worm (*Lyctus striatus*).

In coöperation with Dr. J. A. Lintner, State entomologist of New York, and Jas. Fletcher, entomologist of Dominion of Canada, experiments were carried on to ascertain the effect on bees of spraying trees with Paris green while in bloom. The author conducted a series of experiments, spraying plum, apple, and crab apple trees and raspberries, with a solution of Paris green 4 oz. to 50 gal. of water. The trees were sprayed while in full bloom and in some cases bees were colonized under the trees, their escape being prevented by mosquito netting. Dead bees were soon noticed, and when examined traces of arsenic were found in them. It was also found in the contents of their abdomens, and there is evidence that the sudden death of larvæ was due to the introduction of arsenic from without. The author thinks the proof conclusive that spraying arsenites on trees while in bloom is injurious to bees in proportion as the weather is favorable for their activity. The danger will not be passed until all bloom has fallen from the trees. On this account spraying should not be done while trees are still in bloom.

Notes are given on the feeding habits of slugs (*Limax campestris*), in which it appears they destroy many plant lice in greenhouses and conservatories.

Report on insect pests, A. KOEBELE (*Hawaiian Planters' Monthly, 15 (1896), No. 12, pp. 590–598*).—An important report submitted to the chairman of the committee on diseases and insect pests of the sugar cane. The Hawaiian Islands are fortunate with regard to plant diseases and insect pests of the sugar cane when compared with the Fiji Islands and cane-growing regions in Australia. The cane borer (*Sphenophorus obscurus*) is the most injurious enemy of the sugar cane present in the Hawaiian Islands. Its ravages exceed those of all other insects combined. Its attacks seem confined to the moister localities. It is recommended to burn the trash as soon as possible after the cane is cut, and trap the mature beetles with pieces of split cane placed about 10 ft. apart in spots most affected by the beetles. By this latter remedy enormous numbers of beetles were collected by children in Fiji, who were compensated at the rate of a small sum per pint.

The larva of a Lamellicorn beetle (*Ægosoma reflexum*) has damaged coffee trees by feeding upon the roots. Prolonged irrigation is recommended as a remedy. The cocoa palms are injured by the destruction of the leaves by the larva of a moth of the genus Botis. The same insect also feeds upon sugar cane, banana, and other plants. Large numbers of a parasitic hymenopteron (*Chalcis obscurata*) were introduced in 1895 from China and Japan. This parasite is said to have established itself and to have done a great deal of good by destroying the Botis. The common grass worm of the southern United States (*Laphygma frugiperda*) does considerable damage in Hawaii. It is also found in Brazil. A species of mole cricket (*Gryllotalpa* sp.) has appeared in very large numbers in some of the moist valleys on the island of Oahu. The author thinks it an Asiatic introduction. It destroys seed cane. The

white louse of the sugar cane (*Dactylopius calceolaria*) has been practically destroyed by an introduced ladybird (*Cryptolæmus montrouzieri*). A plant louse of the genus Aphis damages some fields, but has been limited by an introduced ladybird (*Coccinella repanda*).—L. O. HOWARD.

Constitution and development of termites, B. GRASSI and A. SANDIAS (*Quart. Jour. Micros. Science, n. ser., 39 (1896), No. 3, pp. 245–322, pls. 5*).

Description of the botfly of the cottontail rabbit in New Mexico, C. H. T. TOWNSEND (*Psyche, 8 (1897), No. 249, pp. 8, 9*).—*Cuterebra lepusculi* is described as a new species.

Ravages caused in Algeria by caterpillars of Sesamia nonagrioides, J. K. D'HERCULAIS (*Compt. Rend., 123 (1896), No. 20, pp. 842–845; Jour. Agr. Prat., 61 (1897), I, No. 3, pp. 104–106*).—An account is given of the injury produced upon maize, sugar cane, sorghum, etc., in Algiers, with suggestions for their prevention.

The red-headed flea beetle, F. THOMAS (*Ztschr. Pflanzenkrank., 6 (1896), No. 5, pp. 270–275; Ent. Nachrichten, 22 (1896), No. 17–18, pp. 257–259*).—Notes are given of *Halticus saltator*, which is especially injurious to cucumbers in greenhouses.

The woolly aphis or American blight (*Leaflet 34, Board Agr. London, England, 1896*).—Notes are given of *Schizoneura lanigera*.

Fruit bark beetle, F. M. WEBSTER (*Ohio Hort. Soc. Rpt. 1895–'96, pp. 94–98*).—Notes on *Scolytus rugulosus*.

The red scale of Florida, E. E. BOGUE (*Ohio Hort. Soc. Rpt. 1895–'96, pp. 137, 138*).—Notes are given of *Aspidiotus ficus*, a new horticultural insect enemy in Ohio.

A destructive plant parasite, H. LEVAY (*Rev. Scient., ser. 4, 6 (1896), No. 4, pp. 124, 125*).—A report is given of the ravages and distribution in Tahite of *Aspidiotus vastatrix* or *A. perniciosus*.

Eumolopus vitis on grape stock, K. SAJO (*Illus. Wochenschr. Ent., 1 (1896), No. 32, pp. 501–506*).

Bookworms in America, A. C. FRYER (*Proc. Bristol Nat. Soc., 8 (1896), No. 1*).

Pests of grain crops, G. MCCARTHY (*North Carolina Sta. Bul. 128, pp. 147–155*).—This is a popular bulletin in which formulas are given for fungicides and insecticides, and the principal fungus and insect pests, with recommendations for their prevention, of the following grains: Barley, buckwheat, Indian corn, millet, oats, rice, rye, sorghum, and wheat.

Meadow insects, V. MAYET (*Prog. Agr. et Vit., 26 (1896), No. 50, pp. 668–671*).—Notes are given of *Charæas graminis*, *Melolontha vulgaris*, *Rhizotrogus solstitialis*, *R. cicatricosus*, and *R. rufescens*.

Insects injurious in 1895, O. LUGGER (*Minnesota Sta. Rpt. 1895, pp. 99–244, pls. 16, figs. 44*).—A reprint of Bulletin 43 of the station (E. S. R., 8, p. 144).

Report on the introduction and dissemination of injurious insects, F. M. WEBSTER (*Ohio Hort. Soc. Rpt. 1895–'96, pp. 190–195*).

Injurious insects and fungi (*Jour. [British], Board of Agr. 3 (1896), No. 3, pp. 273–293, figs. 7*).—Notes are given on the army worm, woolly aphis, corn moth (*Citotroga cerealella*), a lily disease (*Polyactis [Botrytis] cana*), a disease of snowdrops, the narcissus fly (*Merodon narcissi*), smut of brome grass (*Ustilago bromivora*), and the mildew of hops.

On legislation pertaining to the introduction and spread of injurious insects, O. W. ALDRICH (*Ohio Hort. Soc. Rpt. 1895–'96, pp. 200–202*).

Report on the best legislation regarding the introduction and spread of weeds, insects, and fungi, W. R. LAZENBY (*Ohio Hort. Soc. Rpt. 1895–'96, pp. 202–205*).

Insecticides (*Mississippi Sta. Rpt. 1895, p. 103*).—Tabulated analyses of 4 samples of Paris green.

A contagious disease of white grub, J. B. SMITH (*Garden and Forest, 9 (1896), No. 461, p. 519*).—A brief note is given on the difficulty and apparent uselessness of disseminating the disease.

FOODS—ANIMAL PRODUCTION.

Examination of food products sold in Connecticut, A. W. OGDEN, A. L. WINTON, and E. H. JENKINS (*Connecticut State Sta. Bul. 123, pp. 79*).—The pure-food law and the Connecticut laws regarding the adulteration of food and drugs are quoted. Maple sirup, maple sugar, sirup, sugar, strained honey, comb honey, cream of tartar, lard, pepper, mustard, milk, cheese, coffee, and cereal foods were examined. The methods of testing sugars and sirups, pepper, mustard, cheese, and coffee, and of detecting lard adulteration, are given at length, and the results of the various investigations are discussed in detail. The number of specimens of each article examined and the numbers which were pure, doubtful, and adulterated are given in the following table:

Results of examination of foods and condiments.

	Examined.	Pure.	Doubtful.	Adulterated.
Maple sirup	61	48	5	8
Maple sugar	7	7		
Sugar	16	16		
Sirup	4	4		
Strained honey	48	43		5
Comb honey	12	12		
Lard	118	75		43
Pepper	102	62	8	32
Mustard	69	15		54
Cheese	72	72		
Coffee	124	53		69
Milk	105	82	11	12
Cream of tartar	103	72		31
Cereal foods	9	9		
Total	848	570	24	254

Fodder analyses, C. L. PENNY (*Delaware Sta. Rpt. 1895, pp. 197–199*).—Analyses are given of bran, corn-and-cob meal, cotton-seed meal, cowpea-vine silage, sweet-corn silage, green rye for silage, oats, Canadian peas, a mixture of oats and Canadian peas, corn silage, mixed clover hay, and beets. The composition of some of these samples is given in the following table:

Analyses of silage and green fodder.

	In fresh or air-dry material.						In dry matter.			
	Water.	Protein.	Fat.	Fiber.	Nitrogen-free extract.	Ash.	Protein.	Fat.	Fiber.	Nitrogen-free extract.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Cowpea-vine silage	80.24	2.57	0.60	6.43	8.18	1.98	13.02	3.05	32.52	41.37
Do	76.56	3.42	1.07	6.24	10.15	2.56	14.63	4.57	26.62	43.27
Sweet-corn silage	70.26	2.56	.54	7.22	17.19	2.23	8.61	1.85	24.27	57.76
Green rye for silage	74.92	2.30	.92	8.37	11.84	1.65	9.18	3.69	33.34	47.21
Mixture of oats and Canadian peas	76.13	2.61	.86	7.58	11.32	1.50	10.94	3.60	31.76	47.41

The 2 samples of cowpea-vine silage were from the same source, the first being taken February 8, and the second April 26. The green rye was sampled May 3, and the oats and peas the latter part of June.

Dietary studies at the University of Missouri in 1895, and data relating to bread and meat consumption in Missouri, H. B. GIBSON, S. CALVERT, and D. W. MAY; comments by W. O. ATWATER and C. D. WOODS (*U. S. Dept. Agr., Office of Experiment Stations Bul. 31, pp. 24*).—Two dietary studies were made of a students' club at the University of Missouri. The methods followed were those mentioned in Bulletin 21 of this Office (E. S. R., 7, p. 148). A number of Missouri foods were analyzed. The composition of other foods was computed from standard tables. Tables are given which show the amount and kind of food purchased, wasted, and eaten, and its composition and fuel value. The results of these studies are briefly summed up in the following table:

Results of dietary studies—food eaten per man per day.

	Nutrients.			Fuel value.
	Protein.	Fat.	Carbohydrates.	
	Grams.	*Grams.*	*Grams.*	*Calories.*
First dietary study	96	155	417	3,540
Second dietary study	96	165	404	3,585

In the comments on these dietary studies the results are compared with the results of similar studies made in Tennessee and Connecticut.

Statistics were gathered regarding the kinds of bread and meat consumed by people of different classes in Missouri. The results are expressed in tabular form.

"There is relatively much less raised bread and more corn bread and biscuit eaten in the country than in the town. It would seem natural to assume that the larger proportion of yeast-raised bread in the cities is due to bakers, to the ease with which good quick-acting yeast can be obtained, and to the fact that city people have more convenient markets to buy in and more ready money. The effect of supply upon the kinds of meat eaten is even more evident. Pork is easily raised on the farm, and in the form of salt pork, bacon, and ham is readily preserved for later use. On the other hand, city people can always have fresh beef, veal, and mutton from the markets. That this accounts largely for the fact that pork constitutes 57 per cent of the meat supply of the farmers' families and only 27 per cent of that of families living in the large towns is hardly to be doubted, though, of course, the relative cost may be a factor also. The fact that beef, veal, and mutton make more than half of the total meats eaten by well-to-do people in the cities and less than a quarter of that used by thrifty farmers is naturally explained in the same way."

Composition and digestibility of corn silage, cowpea silage, soja-bean silage, and corn fodder, C. G. HOPKINS (*Illinois Sta. Bul. 43, pp. 181–208*).—The digestibility of corn silage, cowpea silage, soja-bean silage, and corn fodder was determined in experiments made with 4 grade Shorthorn steers, about 2 years old, weighing on an average 1,100 lbs. Each experimental period was of 6 days' duration and was preceded by a preliminary period of 1 week. The steers were fed twice a day and were given all they would eat up clean.

"Three composite samples of the feed were analyzed in each experiment, thus showing the average composition of the feed for 2 periods of 2 days each . . . Two composite samples were made of the refuse [and of the manure] from each steer, one for a period of 2 days and the other for a period of 4 days."

The results of the experiments are expressed in full in tabular form. In the following table the coëfficients of digestibility are given:

Coëfficients of digestibility in experiments with steers.

	Dry matter.	Protein.	Fat.	Fiber.	Nitrogen-free extract.	Ash.
Corn silage:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Steer 1	61.7	51.3	80.9	55.6	69.4	28.9
Steer 2	61.9	51.7	78.9	58.0	67.6	35.0
Steer 3	59.8	52.6	80.2	53.2	66.1	31.9
Steer 4	63.5	54.2	80.2	60.1	69.4	32.0
Average	61.7	52.4	80.1	56.7	68.1	32.0
Cowpea silage:						
Steer 1	59.9	57.5	63.6	51.0	73.1	32.0
Steer 2	59.5	56.7	62.2	52.7	72.1	30.4
Steer 3	59.0	57.5	62.2	50.2	72.6	29.1
Steer 4	60.1	58.2	62.2	53.8	72.3	29.7
Average	59.6	57.5	62.6	52.0	72.5	30.3
Soja-bean silage:						
Steer 1	49.8	55.2	46.9	44.1	60.9	27.2
Steer 2	49.8	55.2	48.5	42.2	61.4	29.4
Steer 3	49.4	54.8	47.7	42.1	61.4	27.5
Steer 4	50.1	56.2	52.5	43.2	61.3	27.7
Average	49.8	55.3	48.9	42.9	61.2	28.0
Corn fodder:						
Steer 1	66.1	41.5	77.4	67.7	70.9	24.0
Steer 2	57.2	30.5	64.7	67.0	61.2	21.4
Steer 3	58.0	35.1	72.9	61.4	60.7	14.1
Steer 4	64.8	41.9	74.6	68.0	69.7	18.3
Average	61.5	37.2	72.4	66.0	65.6	19.4

The coëfficients of digestibility of corn silage, soja-bean silage, and corn fodder are compared with similar results obtained in other American experiments.

The author draws the following conclusions:

"The composition of cowpea silage corresponds very closely to that of clover hay, the most important difference being in the higher percentage of fat found in the clover, but the digestibility of the cowpea silage is so much greater that it furnishes an equal amount of fat and much more protein and total energy than the clover hay.

"Soja-bean silage resembles clover hay both in composition and digestibility. It furnishes an equal amount of protein, more fat, but less total energy than clover hay. . . .

"Corn fodder and corn silage have about the same digestibility for total dry matter and furnish nearly equal amounts of energy. The fodder furnishes more digestible carbohydrate extract, but the silage slightly more of the other nutrients.

"As compared with cowpeas and soja beans, the corn fodder and corn silage have a much higher value for energy or fat production, but the cowpea silage and soja-bean silage are far more valuable for animal growth or the production of milk."

In an appendix the author discusses briefly the composition, digestibility, and uses of foods, and gives in tabular form the composition and digestibility of some American feeding stuffs. Wolff's feeding standards are also quoted.

Digestion experiments (*Mississippi Sta. Rpt. 1895, pp. 79–89*).—Seven tests are reported with sheep to determine the digestibility of vetch (fed green), red clover hay, hairy vetch (fed green), crab grass hay, Johnson grass hay, and a mixture of 1 part of cotton-seed meal and 15 parts of crab grass hay. Five lots of 2 animals, one of 5, and one of 6 were used. Full data for the experiments are tabulated, including analyses of the feeding stuffs, and uneaten portions, and of the dung.

"In collecting the excrement duck bags 6 by 12 in. in size were used. The bottom of these bags was so constructed as to be closed by means of one side extending longer than the other and buttoning up over the opening; thus furnishing a means of collecting the excrement of the day without removing the bags from the sheep."

The coëfficients of digestibility for each sheep with each feeding stuff are given in the following table:

Coëfficients of digestibility of various feeding stuffs in trials with sheep.

	Dry matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Red clover hay:						
Sheep 1	56.4	61.2	50.9	57.0	59.3	34.1
Sheep 2	54.6	58.1	45.9	55.1	58.6	31.4
Average	55.5	59.7	48.4	56.1	58.9	32.7
Vetch, fed green:						
Sheep 1	61.6	71.2	57.2	45.8	74.8	17.2
Sheep 2	62.1	71.7	60.0	42.5	77.4	17.5
Average	61.8	71.4	58.6	44.2	76.1	17.3
Hairy vetch, fed green, first sample:						
Sheep 1	67.7	82.7	62.6	54.8	75.0	45.7
Sheep 2	67.2	79.6	70.9	51.8	81.5	48.9
Average	67.4	81.1	66.7	53.3	78.2	47.3
Hairy vetch, fed green, second sample:						
Sheep 1	78.5	88.5	81.2	72.9	83.0	55.4
Sheep 2	73.9	85.8	79.5	68.6	77.0	49.5
Sheep 3	75.8	85.5	76.9	65.7	80.1	47.3
Sheep 4	76.6	86.7	81.6	70.3	82.1	50.6
Sheep 5	72.4	85.2	75.6	64.1	78.8	44.6
Average	75.0	86.3	78.0	68.3	80.2	49.5
Crab grass hay:						
Sheep 1	57.2	55.7	52.0	58.1	58.9	32.2
Sheep 2	55.7	54.6	49.8	61.3	57.1	29.0
Average	56.5	55.1	50.9	59.7	58.0	30.8
Johnson grass hay:						
Sheep 1	58.0	38.8	37.9	72.1	58.6	7.3
Sheep 2	58.7	37.4	36.4	74.8	59.9	2.4
Average	58.4	38.1	37.2	73.5	59.3	4.8
Crab grass hay and cotton-seed meal:						
Sheep 1	57.1	61.3	48.0	62.4	59.4	23.9
Sheep 2	55.4	56.8	47.9	62.6	57.7	23.0
Sheep 3	58.7	58.8	56.9	64.4	60.8	28.0
Sheep 4	64.8	62.3	64.6	68.5	68.0	38.4
Sheep 5	60.1	64.7	58.8	62.8	62.5	29.8
Sheep 6	62.1	67.8	63.7	65.5	64.2	31.3
Average	59.7	61.9	56.6	64.4	62.1	29.1

An experiment was also made with 2 lots of 5 and 6 sheep to test the relative digestibility of hairy vetch (fed green) and hairy vetch hay. The methods followed were in general those described above. The results are briefly summarized in the following table:

Coëfficients of digestibility of hairy vetch (fed green) and hairy vetch hay in trials with sheep.

	Dry matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hairy vetch, fed green:						
Sheep 1	66.5	79.4	66.3	59.7	69.0	41.6
Sheep 2	68.9	81.8	69.1	62.5	73.3	36.3
Sheep 3	65.9	79.8	65.7	59.4	69.6	33.0
Sheep 4	66.8	80.6	70.4	62.1	68.1	35.4
Sheep 5	72.2	83.7	74.5	65.5	73.2	46.6
Average	68.0	81.0	69.2	61.8	70.6	38.5
Hairy vetch hay:						
Sheep 1	69.1	81.0	69.8	61.1	72.8	43.1
Sheep 2	69.2	82.3	74.0	61.4	71.4	42.8
Sheep 3	69.6	82.5	69.7	60.6	73.0	45.6
Sheep 4	68.0	81.8	69.9	60.0	72.4	34.0
Sheep 5	71.2	83.2	69.4	63.0	75.1	46.3
Sheep 6	69.2	83.2	69.3	60.4	72.5	41.8
Average	69.4	82.3	70.3	61.1	72.9	42.2

A third experiment was made with red clover hay to compare the relative digestive power of steers and sheep. Three steers and 5 sheep were used in this trial. Analyses are given of the amount eaten and digested and of the dung. "The excrement was collected by a detail of assistants, who remained with the steers constantly and used every precaution to prevent the excrement reaching the floor."

The coëfficients of digestibility for each animal are given in the following table:

Coëfficients of digestibility of red clover hay in trials with steers and sheep.

	Dry matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Ash.
Steers:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
No. 1	61.0	61.5	70.1	55.4	69.5	20.5
No. 2	52.3	50.5	62.6	48.4	62.0	0
No. 3	55.9	56.9	65.2	54.0	63.8	16.2
Average	56.4	56.3	65.9	52.6	65.1	12.2
Sheep:						
No. 1	67.3	65.0	67.8	70.0	71.6	41.0
No. 2	64.8	68.0	68.3	62.9	70.2	36.5
No. 3	62.9	64.3	64.5	59.5	70.5	33.2
No. 4	60.8	59.4	62.0	62.1	66.5	30.4
No. 5	63.3	63.9	67.9	62.7	69.4	31.6
Average	63.8	64.1	66.5	63.4	69.6	34.5

"The great variations in these results were undoubtedly due to the individuality of the animals. Steer No. 1 was in good health and readily ate all that was given him, and gained weight during the experiment. . . . The coëfficient of digestibility of Steer No. 1 we believe comes nearer representing the true relative digestive power of steers as compared with sheep."

Report for 1895 of the agricultural station at Gembloux, Belgium, A. PETERMANN (*Chem. Ztg., 20 (1896), No. 64, p. 627*).—This is a very brief account of the work done by this station during 1895. Among the things enumerated are studies on the composition of some fruit wines, the water in honey, the questions whether the chemicals used to sterilize excrements act injuriously on cultivated plants, the injuriousness of certain oil cakes, the warming and cooling of sandy clay soils, effect of the seed bed on the germination test, examination of peat rich in nitrogen, examination of glucose sirups, gummosis in sugar beets, and the composition of pumpkins. In most cases no accounts are given of the studies or results.

The composition of pumpkins (not described) is given as follows: Water 91.83, fat 0.14, crude protein 1.15, carbohydrates 5.50, cellulose 0.94, and ash 0.44 per cent. The ash of pumpkins grown on a sandy clay soil contained 43.83 per cent of potash and 15 per cent of phosphoric acid. The seeds contained in dry state 36.62 per cent of an edible oil, liquid at ordinary temperatures and similar to almond oil in taste. It is characterized by a refraction of 82 at 15.5° C., 73.3 at 30° C., and 70 at 37° C. The residue from the extraction of this oil is said to be an exceptionally fine feeding stuff of high digestibility.

The nutritive value of casein, G. MARCUSE (*Pflüger's Arch. Physiol., 64* (*1896*), *No. 5–6, pp. 223–248*).—The author gives an extended review of the attempts made to determine the nutritive value of casein and reports a number of original experiments. The subjects were 2 dogs. Eight experiments were made in all. Six of these may be divided into series of 2 experiments each. In series 1 and 2 a period on meat diet was followed by a period on casein. In series 3 the order was reversed. The amount of nitrogen consumed daily was practically the same in each case. In experiments 7 and 8 casein and casein-calcium were fed. Fat and starch were fed with the meat and casein; meat extract was generally added to make the food more palatable. With the casein a mixture of salts approximating milk ash was also fed. The water drunk was recorded. The feces were usually separated by feeding infusorial earth or sometimes small porcelain beads in capsules. The nitrogen in the food, urine, and feces was determined. The urine was collected with a catheter.

The results of the experiment are briefly summarized in the following table:

Results of feeding meat and casein.

Food consumed daily.	Experiment No.	Duration of experiment.	Total nitrogen consumed.	Total nitrogen in urine.	Total nitrogen in feces.	Gain (+) or loss(—) in nitrogen.
		Days.	*Gm.*	*Gm.*	*Gm.*	*Gm.*
100 gm. of meat with lard, starch, and meat extract..	1	12	44.679	51.080	1.955	—8.356
27 gm. of casein, with lard, starch, and meat extract.	2	7	25.863	24.276	2.109	— .522
100 gm. of meat with lard, starch, and meat extract..	3	5	18.155	18.531	1.106	—1.482
27 gm. of casein with lard, starch, meat extract, and sodium bicarbonate......	4	5	18.660	18.302	.747	— .389
27 gm. of casein with lard, starch, and salts...........	5	5	17.780	17.895	.672	— .787
100 gm. of meat with lard, starch, meat extract, and sodium bicarbonate..................................	6	7	25.007	23.634	1.167	+ .206
30 gm. of casein, 9 gm. casein-calcium, with bacon, starch, and salts..................................	7	10	67.521	59.007	.909	+7.605
22.5 gm. of casein, 9 gm. casein-calcium, with bacon, sodium bicarbonate, and salts	8	5	30.771	26.472	1.051	+3.248

The conclusion is reached that casein has the same nutritive value as the albumin in meat.

Experiments on the nutritive value of the horse-chestnut, P. GAY (*Ann. Agron., 22* (*1896*), *No. 9, pp. 401–423*).—By analysis and by feeding experiments with sheep, pigs, and a cow the following conclusions were reached: Horse chestnuts have a feeding value about 3 times as great as beets; cooking adds to their value; sheep and cows eat them readily; the quality of the milk is not affected and it was consumed by calves without bad results; pigs do not relish horse-chestnuts.

The formation of pentoses and their behavior in the plant and animal organism, K. GOETZE and T. PFEIFFER (*Landw. Vers. Stat., 47* (*1896*), *No. 1, pp. 58–93*).—The authors made a number of experiments with oats, beans, and peas to find (1) at what stage of growth pentoses are formed, (2) the relation of pentoses to the formation of other substances, and (3) the influence of light on the formation of

pentoses. In the belief that pentoses were concerned in the formation of hippuric acid a feeding experiment, divided into 4 periods, was made with a sheep. A basal ration of 1 kg. of alfalfa hay was fed. The experiment was preceded by a preliminary period of 8 days. In the first period (8 days) nothing was added to the basal ration; in the second period (10 days) 50 gm. of cherry gum (yielding arabinose) was added; in the third period (5 days) 100 gm. of pure arabinose; and in the fourth period (3 days) 120 gm. of pure arabinose. The total nitrogen and hippuric acid in the urine, and the pentoses in urine and feces were determined. The coëfficients of digestibility of the pentoses were 44.6 per cent in the first period, and 54.3 per cent in the second period.

The following conclusions were reached:

The formation of pentoses begins with the growth of the plant, and the pentoses, analogous to true carbohydrates, may be used as a reserve material when plants are kept from the light and the power of assimilation is thus removed. The formation of pentoses is intimately connected with the formation of crude fiber, *i. e.*, cellulose, and though it may not have a direct influence on the lignification of the cell membrane it is nevertheless noticeable that it probably always accompanies this process.

Judging from the plants investigated the cereals or grasses are especially rich in pentoses, while the legumes contain much smaller quantities.

Pentoses are in part assimilated by the animal organism and in part excreted. In the investigation with Herbivora (sheep) no appreciable amount of pentose was found in the urine. It would appear that the pentoses are closely connected with the formation of hippuric acid, since the consumption of large quantities of easily digested pentoses produces an abundant excretion of hippuric acid.

The absorption of water by the gluten of different wheats, F. B. GUTHRIE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 9, pp. 583–590*).—In a paper read before the Royal Society of New South Wales the author describes a number of experiments on (1) the strength, *i. e.*, the amount of water which flour made from various sorts of Australian-grown wheat would absorb, (2) the gluten content, (3) the proportion of glutenin and gliadin in the gluten, and (4) the physical nature of the gluten of the various flours.

The results are given in tabular form. In the author's opinion the experiments point to the following conclusions:

"The strength or water-absorbing capacity of a flour depends directly upon the relative proportion in which the 2 proteids are present in the gluten.

"If the gluten contents of 2 flours be nearly the same, that will be the stronger flour which contains the larger proportion of glutenin.

"Flours in which glutenin preponderates yield strong, tough, elastic, nonadhesive glutens.

"Increased gliadin content produces a weak, sticky, and inelastic gluten."

The decomposition of fat by molds, H. RITTHAUSEN and BAUMANN (*Landw. Vers. Stat., 47 (1896), No. 4–5, pp. 389, 390*).—Two samples of rape-seed cake were analyzed and then kept in unopened glass stoppered bottles for 2 years, when they were again analyzed. The water had increased from 12.45 and 12.31 per cent in the original to 21.94 and 23.42 per cent in the 2-year-old material. The fat, which was 10.53 and 8.50 per cent in the original, had diminished to 1.98 and 1.87 per cent, equivalent to a loss of 81 and 78 per cent, respectively. The authors believe the water could not have come from any other source than the decomposed fat.

Fifteen different species of molds and bacteria were isolated.

Cattle feeding in Colorado, W. W. COOKE (*Colorado Sta. Bul. 34, pp. 3–36*).—In an article on cattle feeding in Colorado the author discusses ranging and winter feeding, marketing, cost of ranging cattle, growth and losses, and shipping.

Experiments in steer feeding, 1894–'95 (pp. 15–30).—A feeding experiment was made with 18 grade Durham and Polled Angus steers. Six of these were 4 years old and weighed about 1,300 lbs.; 4 were 2 years old and weighed about 1,000 lbs.; and 8 were yearlings, weighing from 660 to 830 lbs. A preliminary test was made lasting from December 19 to 27. The 4-year-old steers were fed cut alfalfa hay; they consumed 36 lbs. per head daily and made an average daily gain per head of 1 lb. The other steers were fed whole alfalfa hay. The 2-year-old lot consumed 22 lbs. per head daily and made an average daily gain per head of 1.7 lbs. The yearlings consumed 19 lbs. per head daily and made an average daily gain of 2.2 lbs. "It will be seen that the steers did not eat an amount of hay proportioned to either their size or their age."

The steers were divided into 6 lots as nearly even as possible. The feeding test proper lasted from December 27 to March 18. A basal ration was fed of 5 lbs. of cut corn fodder and 15 lbs. of cut alfalfa hay, to which was added in case of lot 1 cut alfalfa *ad libitum;* lot 2, 6 lbs. of crushed wheat and 20 lbs. of cut beets; lot 3, cut corn fodder *ad libitum;* lot 4, 35 lbs. of corn silage; lot 5, 30 lbs. of cut beets; and lot 6, 8 lbs. of crushed wheat per head daily. The steers were weighed every 2 weeks. The detailed results for each steer are expressed in tabular form. A summary for each lot follows:

Results of feeding experiment with steers in 1894–'95.

Lot.	Total food consumed.					Total digestible dry matter per head daily.	Total gain in weight.	Gain per head daily.
	Hay.	Corn fodder.	Wheat and corn.	Silage.	Beets.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	5,089	1,018	198			12.6	150	0.62
2	3,235	1,094	1,429		4,600	15.8	342	1.41
3	2,948	3,861				11.9	357	1.59
4	2,651	885	27	7,972		15.1	213	.88
5	3,481	1,167			6,800	13.6	273	1.15
6	3,691	1,256	2,024			15.7	252	1.06

The steers were weighed at the station and sold in Denver, where they were again weighed. The shrinkage in weight is discussed. The gains made on each ration and the comparative gains made on the various rations are discussed at length on the basis of the weight of the steers at the station and in Denver.

On either basis corn fodder, silage, and alfalfa are very much alike. The grain-fed steers gained nearly twice as much as those fed alfalfa hay. Comparing alfalfa and beets there was a decided advantage in favor of the beets. More food was consumed with grain and beets than with alfalfa hay alone. No definite conclusion was drawn regarding the comparative value of grain and beets. When extra grain was fed with beets the steers ate much more than on beets or grain alone, and better returns were obtained with both feeding stuffs alone than in combination.

The financial statements are based on alfalfa and beets at $4, corn fodder $5, silage $3, and grain $15 per ton. The cost of each lot, of the food consumed, and the profits are shown in the following table:

Financial results of feeding experiment with steers in 1894–'95.

Lot.	Cost, Dec. 27.	Value of food eaten.	Selling price in Denver.	Profits.
1	$84.70	$14.19	$115.24	$16.35
2	82.36	29.32	124.29	12.61
3	84.32	15.53	114.95	15.10
4	84.81	19.68	109.98	5.49
5	83.44	23.46	119.87	12.97
6	87.41	27.00	128.36	13.95

"It will be seen from this that the largest increase in market value is made by the lot on beets and grain, followed by the grain, and then by the beets; the least by the silage. The value of the food eaten follows in the same proportion for the first three, but the alfalfa lot is the cheapest food, and the fodder corn next, leaving the silage about the middle."

The net returns per ton for the alfalfa fed to the different lots, based on the prices mentioned above, are stated to range from $8.12 with lot 4 to $17.70 with lot 3.

The relation between the age of the steers and the gain, shrinkage, profit, etc., is discussed at considerable length.

"The important lesson to be learned from this test is that well-bred steers that have been wintered on hay the first season can be profitably fed for beef and marketed when they are coming 2 years old. This cuts off from 1 to 2 years from the present common method of running cattle on the range. It allows more head of stock to be kept on a given range and adds at least one-half to the number that can be turned off each year."

Experiments in steer feeding, 1895–'96 (pp. 31–36).—A feeding experiment having 2 periods was made with 15 grade steers divided into 5 lots of 3 steers each. Three of the steers were 2 years old and the remainder 3 years old. In the first period, which lasted from November 7 to December 19, lots 1 and 4 were fed alfalfa hay only; lot 2, alfalfa hay and

beets, beginning with 5 lbs. per head daily and increasing 1 lb. per day until 25 lbs. was fed; lot 3, alfalfa hay and 10 lbs. of corn silage, the latter being increased later to 20 lbs.; and lot 5 was "turned into a fairly good pasture and fed in addition all the hay they would eat." The food consumed and the gains made are shown in the following table:

Feeding experiment with steers in 1895–'96, Period I.

Lot.	Total food consumed.			Gain in weight.
	Alfalfa hay.	Silage.	Beets.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	4,552	....	....	90
2	4,283	....	3,015	88
3	4,472	2,250	....	80
4	4,230	....	....	115
5 (pasturage)	....	....	....	55

"On alfalfa alone the average gain of the 6 steers was 112 lbs. in live weight in 42 days, or 2.4 lbs. per head per day. This is a greater gain than was made by either of the lots having silage or beets in 1894–'95. . . .

"The result of 2 years' feeding of silage shows that it is not a profitable feed for steers that are fed in the open air without shelter. . . .

"The beets were eaten greedily and were fed in liberal quantities. The steers ate . . . in addition, about as much hay as the steers that had nothing but hay. As they gained less on hay and beets than they did on hay alone, the beets were apparently more than wasted."

The second period lasted from December 19 to April 6, and included all except the pastured lot. All were fed alfalfa hay, and in addition lot 1 received corn, lot 2 wheat and beets, lot 3 barley, and lot 4 barley and beets. Heavy rations were fed in each case. The steers were sold in Denver at the close of the test. The data are summarized in the following table:

Feeding experiment with steers in 1895–'96, Period II.

Lot.	Food consumed.					Gain in weight per head.	Shrinkage in shipping.
	Hay.	Corn.	Wheat.	Barley.	Beets.		
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	9,195	2,334	....	237	756	155	[1] + 8
2	7,938	237	2,352	....	6,936	163	27
3	8,898	....	....	2,574	....	76	37
4	7,524	....	237	2,256	5,694	141	66

[1] Increase over weight at station.

"[Comparing corn and barley,] the growth is decidedly in favor of the corn. Not only did the corn make a larger growth, amounting to 79 lbs. per head, but this growth was so much firmer that it shrank less in shipment. . . . The wheat and beets produced only 8 lbs. more growth per head than the corn. The growth was soft, and shrank considerably in shipping."

The steers on barley and beets made better gains than those on barley alone. They grew "nearly as fast as those on corn, but lost much of this gain in shipping, leaving the corn far ahead." However, they

gained less and shrank more than those fed wheat and beets. Barley alone or with beets does not seem to make as hard flesh and fat as corn or wheat.

Maturing skim-milk calves, C. F. CURTISS (*Iowa Bul. 32, pp. 448–460, fig. 1*).—This is a continuation of an experiment reported in Bulletin 25 of the station (E. S. R., 6, p. 453). The experiment was made with 6 high-grade Shorthorn calves. At the conclusion of the 90-day skim-milk period mentioned in Bulletin 25 the calves had gained 857 lbs. The average weight of the calves was 247 lbs. The present test lasted from December 25, 1893, until December 1, 1895. They were castrated soon after the test began and fed liberally on grain and hay, but were not forced until toward the close of the experiment. They were pastured during June and July. Full details of the experiment are given in tabular form.

The average gain per head daily for the entire period including milk feeding was 1.72 lbs. The average gain per head daily for the entire period not including pasturage was 1.91 lbs. The average cost of feed per pound of gain for the entire period was 4.8 cts. The cost of food is based on ear corn at 46 cts., "snapped" corn 37.5 cts., corn meal 62.5 cts., shelled corn 57.5 cts., ground oats $1, bran 70 cts., sheaf oats 50 cts., stock beets 5 cts., corn-and-cob meal 60 cts., whole oats 94 cts., linseed meal $1, cotton-seed meal 85 cts., gluten meal 75 cts., ground flaxseed $1.25, ground wheat $1, hay 30 cts., green clover 2.5 cts., green peas 2.5 cts., green corn fodder 2.5 cts., and dry corn fodder 20 cts. per 100 lbs. There was a loss of weight while the steers were at pasture. "This was an unexpected result, and can only be accounted for on the ground that the pasture, being blue grass and timothy, had become too dry and ripe to afford good results."

The advantage of marketing the cattle earlier is discussed at length. The author concludes that it would have been more profitable to sell the cattle at the end of 17 months than at the close of the experiment.

At the conclusion of the test the cattle were sold in Chicago and slaughtered. The price received was $4.85 per 100 lbs. They were sold, in the author's opinion, at a decidedly unfavorable time. A few lots of cattle sold on this day brought a higher price than those in the test. The author believes that their failure to take highest rank was due to their inferior breed. The total live weight was 8,460 lbs., dressed weight 5,471 lbs., and the percentage of dressed beef 64.9.

"The percentage of dressed meat is high; the meat was of prime quality, and the percentage of weight in the high-priced cuts averages fully as good as any former lot that we have fed. The claim that cattle of this age contain less fat and consequently kill more profitably than larger cattle does not seem to have been very fully substantiated."

In the author's opinion these experiments show that—

"The calf is capable of making excellent returns for food consumed, and that good calves can undoubtedly be raised with profit on skim milk and farm feeds. The essential conditions in a successful feeding operation of this kind are, good quality

of stock to begin with, good gains as economically made as possible, and a well-finished, high-selling product in the end. The latter attainment will largely depend upon the preceding factors. Inferior stock will not give sufficient return to justify the expense of feeding for early maturity."

On fattening experiments and slaughter tests with swine, M. HERTER (*Milch Ztg., 25 (1896), No. 44, pp. 697–699*).—The belief is somewhat widespread in Germany that the preponderance of English blood in swine is responsible for the fact that so much of the pork is poor in quality and not suited for the making of sausage and similar purposes. The following test was therefore made with 15 pigs, 13 of which were from the same litter, and were crosses of a Berkshire boar on a half-blood Meissen sow. Seven of the pigs were boars. Six were castrated when 4 weeks old, and the seventh when 3 months old. At the same time 2 of the 6 sows were spayed. The remaining 2 pigs used for the test were from another litter of the same age. They were crosses of a Berkshire boar on a sow with no Meissen blood. They were sows and were not spayed. The feeding of the pigs is discussed at some length. They were slaughtered when 10 months and 18 days old, the average weight being 120 kg. They were judged by experts. The live weight, the weight of flesh and fat in the carcass, and relation of weight of the carcass with and without fat to the live weight of each animal are given in tabular form.

From this test and a test made the previous year the author draws the following conclusions: With abundant but not unusual feeding, cross-bred swine with a large proportion of English blood furnish the quality of pork which is desired. The opinion that such swine furnish low-grade pork is without foundation. It is possible to delay the castration of pigs beyond the usual time, and this may increase the proportion of flesh produced. Spaying was without effect on growth or the production of flesh.

Molasses as food for swine, E. FREDERIKSEN (*Ugeskr. Landmänd, 1896, No. 28; abs. in Milch Ztg., 25 (1896), No. 35, pp. 556–558*).—A test of the feeding value of a feeding stuff made from palm-nut cake and molasses was made with 15 pigs divided into 3 lots of 5 each. Three of the pigs in lot 1, 2 in lot 2, and 1 in lot 3 were barrows, the others sows. The average weight of the animals in each lot was 71.7, 70.6, and 71.9 lbs., respectively. The test began March 2 and lasted 80 days. All the pigs were fed a basal ration of 3 lbs. buttermilk and 12 lbs. whey per head daily. Lot 1 was fed barley in addition, lot 2 barley and molasses feed (2:1), and lot 3 barley and molasses feed (1:1). In every case 2 lbs. per head daily of the additional food was fed at first and the amount was gradually increased to 4 lbs. The composition of the molasses feed is quoted. The food consumed, the gain made by each pig, and the average results are given in tabular form.

The average daily gain in weight of lot 1 was 1.11 lbs., of lot 2 1.05 lbs., and of lot 3 1.10 lbs.—practically the same in each case. Ten of the pigs were sold and slaughtered. The fat was firm and of the best

quality. The cost of the various feeding stuffs is quoted. The cost of 1 lb. gain in live weight was 0.56 ct. cheaper when molasses feed and barley (1:1) were fed than with barley alone. The conclusion is reached that molasses can be advantageously fed to pigs weighing over 50 lbs. Experiments are in progress to test its value with younger pigs.

Analyses of feeding stuffs (*Mississippi Sta. Rpt. 1895, pp. 89–94*).—Analyses of a large number of feeding stuffs are reported. Most of these are the individual analyses from which the averages given in the article in E. S. R., 6, p. 91, were compiled. In addition, analyses are given of the following grasses and other feeding stuffs: *Grasses*—Meadow oat grass (*Avena elatior*), brome (*Bromus pratensis*), Job's tears (*Coix lachrymæ*), and *Triodia seslerioides*. *Leguminous plants*—Peanut hay (*Arachis hypogea*), and vetch (*Vicia acutifolia*). *Miscellaneous*—Chinese vetch (*Vigna* sp.), *Ambrosia trifida*, cow salad (*Discopleura* sp.), Brazilian sponge (*Luffa cylindrica*), *Pyrrhopappus carolinianus*, red clover hay, hairy vetch hay, artichoke, chicken corn seed, shredded Kafir corn, shredded corn, corn, cob, and shucks, corn bran, corn meal, ground corn (4 varieties), corn-and-cob meal, corn-cob-and-shuck meal, jack bean (pods and beans, beans, and hulls), cowpeas, cotton seed meal, cotton-seed (raw and cooked), rice hulls, wheat bran, soja beans, pea-vine hay, Tennessee yam, and Blatchford's Feeding Powder.

Hay substitutes, C. S. PHELPS (*Connecticut Storrs Sta. Bul. 17, pp. 8*).—Details are given regarding soil, seeding, harvesting, yield, preservation, composition, feeding value, and digestibility of the following hay substitutes which can be advantageously used when the hay crop is poor: Hungarian grass, wheat fodder, barley fodder, barley and peas, oat hay, oat fodder, oats and peas, oats and vetch, Canada field peas, red clover, scarlet clover, clover rowen, timothy rowen, rowen of mixed grasses, flat pea, corn fodder, soja-bean fodder, and cowpea fodder. The bulletin is largely based on investigations of the stations.

"Substitutes for the regular hay crop should be grown as far as possible. These may be used either as silage or dried fodders. The silo has proven valuable and economical for the dairy farm. Corn is probably the best silage crop yet tried, but there are others which have a greater feeding value. Soja-beans and cowpeas can be readily grown in Connecticut, and, when mixed with corn fodder, make a silage of higher feeding value than corn alone.

"Among the annual crops for field curing the most valuable seem to be oats and peas, millet, Hungarian, barley and peas, and fodder corn. The feeding value of all of these crops is about equal to, and in some cases higher, than the better grades of hay.

"The legumes, clover, peas, etc., are especially valuable for fodder and for enriching the soil. They may be most advantageously grown and used in the place of the grasses."

The composition, digestibility, and food value of potatoes, H. SNYDER (*Minnesota Sta. Rpt. 1895, pp. 83–96, fig. 1*).—A reprint of Bulletin 42 of the station (E. S. R., 7, p. 974).

Heat equivalent of the nutrients of food, F. STOHMANN (*Ann. Agron., 22 (1896) No. 11, pp. 523–535*).—Translated from the English (E. S. R., 6., pp. 590–608) by J. Crochetelle.

Apples as food, J. J. WILLIS (*Gard. Chron., ser. 3, 20 (1896), No. 533, p. 789*).—A popular article.

Milling and the chemical composition of the product of a modern rye mill, M. FALKE (*Arch. Hyg., 28, No. 1, pp. 49–91, pls. 2*).—The literature of the subject is reviewed at length. The author determined the water, nitrogen, ash, nitrogen-free material (by difference), and in some cases the fat in 76 samples of cleaned rye, rye flour, and the intermediate milling products, and in 5 samples of commercial rye flour. The analyses are given in tabular form. The conclusion was reached that

the nitrogen content of fine rye flour was very low. It differs in this respect from wheat flour. Rye loses much more nitrogen in milling than wheat.

Note on imported wheat and flour, F. B. GUTHRIE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 9, pp. 579–582*).—The author discusses a number of American varieties of wheat and flour and compares them with Australian varieties. The points touched on are the color, strength, gluten content, and nature of the gluten. The bread baked from several flours is also described.

Our daily bread (*Diet. and Hyg. Gaz., 12 (1896), No. 12, p. 761, 762*).

Unclean bakeries (*Diet. and Hyg. Gaz., 12 (1896), No. 12, pp. 765, 766*).—In an article quoted from the *Pacific Medical Journal* the need of inspecting bakeries is pointed out, since in the author's opinion the majority of bakeries are not cleanly.

On the new military bread, BALLAND (*Compt. Rend., 123 (1896), No. 23, pp. 1007–1009; abs. in Rev. Scient., ser. 4, 6 (1896), No. 25, p. 789*).—A description of the new French military bread and analyses of this and several other sorts of bread are given.

Selection, purchase, and valuation of meat and foods made from meat, DRECHSLER (*Auswahl, Einkauf, und Beurtheilung unserer Fleischkost nebst allendie Tierreiche entstammenden Lebensmitteln. Munich: J. Lindauer, 1896*).

Concerning kvass and its manufacture, R. KOBERT (*Ueber den Kwass und dessen Bereitung. Halle: Tauch und Grosse, pp. 32*).—Kvass is a fermented beverage made from ground grains or foods prepared from them. Sugar and flavoring materials may be added.

Progress in the examination of spices and their adulteration, T. F. HANAUSEK (*Chem. Ztg., 20 (1896), No. 80, pp. 775–778*).—A review.

Metallic contamination of food (*Diet. and Hyg. Gaz., 12 (1896), No. 12, pp. 762–764*).—A general article.

The influence of saline mineral waters (Kissingen, Hamburg) on the metabolism of men and on the so-called "curgemässe" diet, C. DAPPER (*Ztschr. Klin. Med., 30 (1896), pp. 3, 4; abs. in Chem. Ztg., 20 (1896), No. 66, Repert., p. 205*).

Is the raising of cattle and horses in sugar-beet farming advisable and profitable? M. FISCHER (*Neue Ztschr. Rübenz. Ind., 37 (1896), No. 14, pp. 171–177*).

Cattle stalls with low mangers, short standing room, and deep gutters, SCHREWE (*Deut. landw. Presse, 23 (1896), No. 38, pp. 331, 332, figs. 2*).

A model stable for cows (*Rural New Yorker, 1896, May 16, pp. 334, 335, figs. 7, dgm. 1*).

The cattle section and dairy matters at the Concours General Agricole at Paris, WERNER (*Mitt. deut. landw. Ges., 1896, No. 10, sup., pp. 1–8*).—A full treatise on the types of the different breeds in France and Germany.

Fattening steers on a ration containing fish meal, K. FINK (*Westphal. landw. Mitt., 1895, Nov. 7; abs. in Milch Ztg., 25 (1896), p. 51*).—Oxen were fed for 90 days a ration containing 3 lbs. fish meal per head per day. Satisfactory gains were made.

Fattening steers in winter, T. SHAW (*Minnesota Sta. Rpt. 1895, pp. 255–279*).—Reprinted from Bulletin 44 of the station (E. S. R., 8, p. 246).

Fattening lambs in winter, T. SHAW (*Minnesota Sta. Rpt. 1895, pp. 280–295*).—Reprinted from Bulletin 44 of the station (E. S. R., 8, p. 251).

Why not improve your poultry? F. E. HEGE (*North Carolina Sta. Bul. 126, pp. 91–96*).—In a brief discussion of the subject the author treats of the magnitude of the poultry industry and gives concise directions for the care of poultry, choice of breeds, and marketing.

"In order to command the highest prices poultry should always be separated into the different varieties, size, and grade. The buyer can then make an intelligent offer and the seller is far better able to demand a reasonable and just price. Anyone taking to market a wagon load of the above stock can, by proper divisions, make the same load net him at least 15 per cent more than if taken in the ordinary manner. Eggs should also receive the same attention."

The animal as a machine, R. H. THURSTON (*North Amer. Rev., 163 (1896), No. 5, pp. 607–619*).

VETERINARY SCIENCE AND PRACTICE.

Cornstalk disease of cattle, N. S. MAYO (*Kansas Sta. Bul. 58, pp. 65–88*).—The author notes the prevalence of the disease, its geographical distribution, and the extent of its injury to live-stock interests. Reference is made to the results reported in Bulletin 10 of the Bureau of Animal Industry of this Department (E. S. R., 8, p. 81) and in station bulletins of studies of the relation of corn smut to this disease, and work in this line at the Kansas Station is described. Corn smut (*Ustilago maydis*) was extracted with alcohol, the alcohol evaporated, and the residue tested on guinea pigs with no apparent ill effect. A chemical test also failed to detect in the smut any alkaloid or nitrogenous base which might be poisonous. The author concludes that corn smut is not injurious to cattle and that it is not the cause of the cornstalk disease.

Growing corn was inoculated with pure cultures of the Burrill bacterial corn disease. The inoculated stalks when ripe were gathered and a 2-year old heifer confined in a stable and fed exclusively upon them for 8 days with no apparent ill effect. Cultures of these corn disease germs in beef broth were given to the heifer as a drench, producing a mild diarrhea. None of the bacilli were found in the blood.

The author states that all indications are to the effect that the cornstalk disease of cattle is not a germ disease, and there is abundant evidence that cornstalks affected with the Burrill corn disease do not cause cornstalk disease in cattle, nor have other injurious effect.

The general symptoms of the disease are those of weakness, often running into paralysis of the hind parts, accompanied by signs of distress. As the disease progresses the symptoms of suffering greatly increase. Death usually occurs within 24 hours after the first symptoms are noticed.

A report is given of several outbreaks. As a means of prevention the cattle should be well fed and watered before starting them in the stalk field, and they should be put upon this feed gradually. Water and salt should be constantly before them. In general, the author states that what may be called typical cornstalk disease in cattle is a combination of indigestion and the action of some toxic substance in the cornstalks, possibly saltpeter.

Bacteriological studies in contagious abortion in cows, F. D. CHESTER (*Delaware Sta. Rpt. 1895, pp. 116–118*).—An outbreak of contagious abortion in cows having occurred in 1894, the subject was investigated by the station officers. Agar slant cultures were made from the placenta of a subject, and later gelatin plate cultures were made from one of the slants. Two colonies developed, one of which was considered nonpathogenic. The other was cultivated in various media, and the biological characters were ascertained for the cultures used. The bacillus was strikingly like *Bacillus coli communis*, and

upon rabbits it proved nonpathogenic. Inoculation experiments made upon a pregnant cow failed to give results. The work is to be continued.

Anthrax, A. T. NEALE ET AL. (*Delaware Sta. Rpt. 1895, pp. 22–46*).—A history is given of epidemics of anthrax in Delaware. It is thought probable that anthrax may have been introduced into the State in goat skins from South America which were unloaded on the banks of the Delaware River. As the result of numerous experiments made to control anthrax by vaccination, reported in a general way, the author states that vaccines which may be used with impunity are available at the station, and that they afford almost complete protection against anthrax to cows at pasture upon infected meadows.

The details are given of 14 tests of the efficiency and safety of vaccines made at the station. The data in some instances are tabulated.

On the germicidal power of menthol vapor and its action on the development of anthrax, F. D. CHESTER (*Delaware Sta. Rpt. 1895, pp. 118–121, fig. 1*).—The author investigated the germicidal power of menthol, using in his experiments a spore-forming bacillus, *Bacillus anthracis*, and a nonspore form, *B. coli communis*. The cultures were made on agar slants. Anthrax spores were not killed after 11 days' exposure to menthol vapor. The vapor prevents the formation of spores and repeated growth under the action of menthol vapor resulted in a degenerate form of sporeless anthrax in which involution forms predominate. Cultures from such sporeless forms will under normal conditions produce spores.

The tests with *Bacillus coli communis* showed that menthol vapor does not appear to prevent or even check its growth.

Tetanus or lockjaw in horses, A. T. NEALE ET AL. (*Delaware Sta. Rpt. 1895, pp. 51, 52*).—A horse receiving a nail puncture in the foot suffered 5 days later from an attack of tetanus. He was treated to subcutaneous injections of the blood serum of a horse which had recovered from tetanus. At the end of 22 days the horse convalesced. It required 1 lb. of serum per 1,000 lbs. of live weight of the subject. The expense for the serum in this case was $50.

Bovine tuberculosis, A. T. NEALE ET AL. (*Delaware Sta. Rpt. 1895, pp. 52–60*).—Herd testing in Delaware is discussed, followed by remarks on tests of the efficiency of the tuberculin prepared at the station and on the question as to whether the effect of tuberculin on incipient bovine tuberculosis is curative. Under the latter head an instance is given of a Guernsey heifer 2 years old, condemned by the tuberculin test in 1893, which was subjected to repeated injections of tuberculin until she wholly ceased to respond and in 1895 was in excellent condition, having been vaccinated in the meantime with attenuated anthrax virus.

Tuberculosis, bacteriological work, F. D. CHESTER (*Delaware Sta. Rpt. 1895, pp. 98–116, fig. 1*).—The method of preparing and testing tuberculin at the station is described in detail. Beef peptone

bouillon in sterilized flasks was inoculated with a culture of the tubercle bacillus and kept at 38 to 39° C. for 6 to 8 weeks. The culture flasks were then heated at 70° C. for 3 hours, the contents filtered, and the filtrate evaporated at 60° to one-tenth the original amount. This preparation was tried on cows with satisfactory results, but the effect on guinea pigs was not so encouraging.

The milk of a tuberculous cow, with no external evidences of any tuberculous lesion of the udder, was fed to guinea pigs in the form of scum from the separator bowl, mixed milk and cream, whole milk, and whole milk sterilized 1 hour, from November 7, 1893, to January 2, 1894, with negative results.

In an examination of about 30 samples of milk for tubercle bacilli the results were negative, except in one case, and the author says, "The simple apparent detection of tubercle bacilli [in the absence of a biological examination] is not sufficient ground for condemning a milk sample."

In an examination of nodular cheesy matter from the lung of a cow no tubercle bacilli were found, but a guinea pig died of general tuberculosis from an abdominal injection of this cheesy deposit.

Weights of cultures of tubercle bacillus, C. L. PENNY (*Delaware Sta. Rpt. 1895, p. 207*).—The author separated and weighed the bacilli in 13 cultures made in the preparation of Koch's tuberculin. The separation was made by means of Gooch crucibles packed with asbestus. The cultures had been made in 50 cc. glycerin bouillon and the weights obtained ranged from 0.1502 to 0.2806 gm., with an average of 0.1939 gm.

On the toxic properties of molds, R. R. DINWIDDIE (*Arkansas Sta. Bul. 40, pp. 35, 36*).—A 2-year-old colt was fed for 3 weeks about 12 ears a day of badly molded and worm-eaten corn along with hay. From January 3 to March 1 artificial cultures of molds on bran, mixed with dry bran were fed with good hay. No harmful results were observed. A second colt, after having eaten moldy corn for 6 weeks, was fed pure cultures of *Penicillum glaucum* for 5 weeks with no apparent ill effects.

Experimental and clinical studies of Aspergillus fumigatus, A. LECET (*Recueil Med. Veterin., 1896, No. 16, pp. 575–614*).

Notes on the nodes found in the lungs, caused by Actinomyces bovis, Micrococcus botryogenus, Strongylus, Echinococci, and Aspergillus, J. T. GLENNON (*Jour. Comp. Med. and Vet. Arch., 1896, No . 6, pp. 442–464*).

Concerning the physiological conditions for spore formation in the anthrax bacillus, H. BUCHNER (*Centbl. Bakt. und Par. Med., 20 (1896), No. 22–23, pp. 806, 807*).

Bacteriological work upon anthrax, F. D. CHESTER (*Delaware Sta. Rpt. 1895, pp. 64–98*).—The writer discusses the bacillus and its detection, the vitality of the anthrax organism, the proper disposal of anthrax carcasses, and the preparation of attenuated virus at the station. Under the last head are given in detail the experimental tests of the virus.

Cerebro-spinal meningitis in horses, A. T. NEALE ET AL (*Delaware Sta. Rpt. 1895, pp. 60–63*).—This is a continuation of work published in the Annual Report of the

station for 1893 (E. S. R., 6, p. 843). The investigation of an outbreak of cerebrospinal meningitis near the station, and a test of oats from Pennsylvania said to have produced the disease, failed to discover any cause.

Controlling erysipelas in swine, H. FRICK (*Berl. tierärtztl. Wochenschr., 1896, No. 28, pp. 327–331*).

Protective inoculation against erysipelas in swine, LORENZ (*Centbl. Bakt. und Par. Med., 20 (1896), No. 22–23, pp. 792–796*).

The repression of foot and mouth disease, HOCK (*Wochenbl. landw. Ver. Baden, 1896, Aug. 12; reprinted in Milch Ztg., 25 (1896), No. 37, pp. 590, 591*).

Glanders, A. T. NEALE ET AL. (*Delaware Sta. Rpt. 1895, pp. 47–51*).—This is a report on detection of cases in Delaware, disinfection of infected premises and the use of mallein in diagnosis.

Mallein tests for suspected glanders in horses, R. R. DINWIDDIE (*Arkansas Sta. Bul. 40, pp. 39–42*).—An account is given, with tabulated data, of tests made with mallein for the detection of glanders. No cases were discovered.

Rinderpest and the Siberian plague in Russia during the first quarter of 1896 (*Veroffentl. de. kaiserl. Gesundh.-A., 1896, No. 31, p. 618*).

Concerning the etiology and prevention of rinderpest, SEMMER (*Deut. Ztschr. Tiermed. u. Vergl. Path., 20, No. 1, pp. 32–46; abs. in Centbl. Bakt. und Par. Med., 20 (1896), No. 22–23, pp. 819–821*).

Texas cattle fever in various localities, R. R. DINWIDDIE (*Arkansas Sta. Bul. 40, pp. 36–39*).—Accounts of outbreaks of the disease in the State with notes on 3 *post-mortem* examinations.

Concerning the spread and the repression of tuberculosis in cattle, D. SEMMER (*Landw. Ztg. St. Petersburg Herald, 21 (1896), p. 99; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 247*).

On the preparation of antituberculin, A. VIQUERAT (*Centbl. Bakt. und Par. Med., 20 (1896), No. 18–19, pp. 674–678*).

The action of preventive serums, BORDET (*Ann. Inst. Pasteur, 1896, p. 193; abs. in Centbl. Bakt. und Par. Med., 20 (1896), No. 20–21, pp. 760–766*).

Investigations of hog diseases, R. R. DINWIDDIE (*Arkansas Bul. 40, pp. 42–44*).—An account of outbreaks of hog cholera in different parts of the State.

Report of the committee on animal diseases and animal food, D. E. SALMON (*Diet. and Hyg. Gaz., 12 (1896), pp. 751–754; reprinted from Jour. Amer. Public Health Assn.*).—In an address delivered before the American Public Health Association in September, 1896, the author describes the cause and prevention of various animal diseases and insists on the need of inspecting milk and meat. Some of the difficulties attending such inspection are pointed out.

Parasites of domestic animals, G. MCCARTHY (*North Carolina Sta. Bul. 127, pp. 101–142, figs. 36*).—The author discusses briefly the general classification of parasites and gives a list of vermicides, with doses for various animals, and formulas for different tonics, washes, liniments, and ointments. The principal parasitic worms and insects affecting cattle, horses, sheep, swine, dogs, and cats are popularly described, with illustrations in most cases; symptoms caused by each are given, and treatment is indicated.

Shoeing for special purposes, E. P. NILES (*Virginia Sta. Bul. 54, pp. 83–94, figs. 10*).—This is a continuation of work published in Bulletin 46 of the station (E. S. R., 8, p. 159).

The following weaknesses or ailments of horses are described: Clicking, interfering, drop sole, knuckling, toe and quarter cracks, contracted feet, corns, and laminitis, and directions are given for shoeing so as to best afford relief or to cure.

Veterinary work (*Mississippi Sta. Rpt. 1895, pp. 59–62*).—An account is given of an outbreak of charbon in 1889, with symptoms, treatment, and preventive measures. Mention is made of a test of the college herd with tuberculin, with no reactions. References are also made to work previously published in Bulletins 16, 25, 31, and 35 of the station (E. S. R., 3, p. 398; 5, p. 78; 7, pp. 65 and 804).

DAIRY FARMING—DAIRYING.

Cattle feeding (*Mississippi Sta. Rpt. 1895, pp. 55–59*).—These experiments are in continuation of work previously reported in Bulletins 13 and 15 of the station (E. S. R., 2, pp. 362, 658; 3, pp. 166, 875).

The present experiments, to determine the relative value of different foods (shown in the table) for the production of milk and butter, were made in 1892 with 30 grade cows divided into 6 lots of 5 each (4 Jerseys and 1 Holstein). The tests lasted 5 weeks. The results are summarized as follows:

Comparisons of different rations for cows.

Lot.	Rations.	Cost of food.	Milk.			Butter.	
			Yield.	Cost per gallon.	Butter fat.	Yield.	Cost per pound.
			Gallons.	*Cents.*	*Per ct.*	*Pounds.*	*Cents.*
1	Bermuda hay, silage, raw cotton seed	$9.65	152.6	6.3	5.95	73.12	13.2
2	Timothy hay, silage, raw cotton seed	11.30	136.3	8.3	5.73	61.30	18.4
3	Bermuda hay, silage, steamed cotton seed	10.79	218.5	4.9	5.85	100.35	10.9
4	Timothy hay, silage, steamed cotton seed	15.32	183.0	8.4	5.88	84.37	18.1
5	Bermuda hay, silage, cotton-seed meal	20.88	212.3	9.8	5.75	95.27	22.0
6	Timothy hay, silage, cotton-seed meal	26.97	213.2	12.6	5.71	95.99	28.1

The results of these experiments agree very closely with those of former years. From all the experiments the following general conclusions are drawn:

"(1) Equal weights of Bermuda and timothy hay have practically equal values in the production of milk and butter.

"(2) At the prices at which they can be purchased in Mississippi, Bermuda hay will produce milk and butter at a much less cost than timothy hay.

"(3) The milk and butter from cows fed on steamed cotton seed costs less than that from cows fed on raw cotton seed, and but little more than one half as much as that from cows fed on cotton-seed meal.

"(4) The butter from steamed seed is superior in quality to that from either raw seed or from cotton-seed meal."

Feeding cotton-seed meal to dairy cows, C. F. CURTISS (*Iowa Sta. Bul. 32, pp. 437–447*).—Using 5 grade Shorthorn cows fresh in milk, the effect was studied of gradually substituting cotton-seed meal for the bran in a grain ration of 12 lbs. of corn-and-cob meal and 6 lbs. of bran daily. There were 6 periods of about 2 weeks each. In the first period no cotton-seed meal was fed; in the second period 2 lbs. of cotton-seed meal was substituted for 2 lbs. of bran, and in subsequent periods it was increased 1 lb. at a time until in the sixth period all the bran was replaced by cotton-seed meal. During the first, second, and third periods each cow received daily 12 lbs. of corn fodder and 4 lbs. of hay, and during the fourth, fifth, and sixth 12 lbs. of hay. The last 2 days of each period butter was made from the milk. This was analyzed and scored by several experts at the station and in Chicago. These data are given in full, but no feeding record is given. Neither the volatile

fatty acids, insoluble fatty acids, saponification equivalent, iodin number, nor melting point seemed to be regularly affected by the increase in cotton-seed meal, though most of these factors varied somewhat during the experiment.

"The average score on flavor ranged from 41 in period 1 on corn-and-cob meal and bran to 41.5 in period 4 where the cows were having 4 lbs. of cotton-seed meal per head daily. . . . In periods 5 and 6, when the amount of cotton-seed meal fed was 5 and 6 lbs., respectively, per head daily, the scores were 40¾ and 40¼, thus the score on flavor of butter ranged nearly as high on 5 and 6 lbs. of cotton-seed meal in the ration as when the cows were fed on a grain ration of corn-and-cob meal and bran."

Samples of the butter kept in the creamery refrigerator for about 2 weeks usually fell off about 1 or 2 points in flavor, except where 5 lbs. of cotton-seed meal was fed, in which case the flavor was scored 5 points lower.

"The opinion that cotton-seed meal feeding even in a moderate degree injures the flavor of butter and gives more solidity and a higher melting point has gained considerable credence among dairymen. This investigation does not indicate that such results may be expected from the use of the feed in amounts within the range here reported, viz, 2 to 6 lbs.

"The work of both the Iowa and the Texas stations does not indicate any particular disturbance of the composition, quality, or flavor of butter from feeding cotton-seed meal in quantities not exceeding 5 lbs. per day. Inasmuch as this is, perhaps, as extensively as it will ever be advisable to feed the meal in Iowa it is safe to conclude that it may be used as a dairy feed without injury to the butter product when the circumstances are such as to warrant its use."

The southern pea vine (*Delaware Sta. Rpt. 1895, pp. 7–21*).—A brief summary is given of 4 years' experiments with the cowpea, covering variety tests, manuring, and the utilization of the crop as green manure, as hay, as pasture, and as silage. A large part of the work has been previously reported in the Annual Reports of the Station for 1891 and 1893 (E. S. R., 5, p. 577; 6, p. 802), but some additional work is given.

For stock feeding the vines have been used as pasture, for soiling, as hay, and as silage. As a hay crop satisfaction has been experienced, as is shown by letters from practical farmers.

In an experiment with 6 cows, divided into 2 lots of 3 each, lasting from February 2 to April 29, 1894, the feeding value of pea-vine silage was compared with that of wheat bran. The trial was divided into 6 periods of about 2 weeks' duration. It was made on a private farm near the station. Seven and 9 lbs. of wheat bran were fed in comparison with 30 and 33 lbs. of pea-vine silage fed with sweet-corn silage, and 9 lbs. of bran was compared with 63 lbs. of pea-vine silage without the corn silage.

Samples of the milk were examined on 5 to 7 days of each period, and the conclusions are drawn from the average results. Tables are given showing the composition of the rations and the milk and butter yield for each cow during 5 to 7 days of each test. The results, which are discussed at length, are briefly summarized as follows:

"In no instance was the substitution of a suitable quantity of [pea-vine] silage for its equivalent in bran accompanied by a decrease in the yield either of milk or

of butter. In several instances a loss of 25 per cent in milk and a corresponding loss in butter followed when bran was substituted for pea vine. In quality the milk from a very heavy pea-vine ration was, after trial, pronounced acceptable by a creamery owner, who is noted for the high grade of his butter."

Feeding dairy cows, J. WILSON (*Iowa Sta. Bul. 32, pp. 408–436, figs. 3*).—This is a continuation of work reported in Bulletin 25 of the station (E. S. R., 6, p. 460). Four Holstein, 2 Shorthorn, and 2 Jersey cows were fed for 77 days, from January 1 to March 18, to compare turnips, mangel-wurzels, sugar beets, and red table beets. Usually each kind of roots was fed for 20 days, the first 10 days being the transition period. A basal ration of hay, corn fodder, bran, gluten meal, and linseed meal was fed throughout. On an average about 18 to 20 lbs. of roots were fed per cow daily. The nutritive ratio of the rations is given as from 1:4.1–4.7. The ration was moistened with water about 12 hours before feeding. The principal results, amount of water consumed, gain in weight, and composition of the beets are given. A summary of the results follows:

Dry matter eaten and yields of milk and fat by cows fed roots.

Roots fed.	Length of period.	Yield of— Milk.	Butter fat.	Butter (calculated).	Dry matter eaten daily per 1,000 lbs. live weight.	Dry matter eaten per pound of butter fat.
	Days.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Turnips	10	2,333	91.19	106.38	21.14	20.51
Mangel-wurzels	10	2,401	88.26	102.97	22.93	23.01
Sugar beets	10	2,336	85.11	99.29	22.87	23.83
Red table beets	9	1,920	72.61	84.71	21.92	24.45

The volatile fatty acids, melting point, and flavor of the butter were as follows:

Examination of butter produced on roots.

Roots fed.	Volatile fatty acids in 5 gm. butter fat.	Melting point.	Flavor (perfect 45).
	Cc.	*Deg. C.*	
Turnips	31.10	32.43	38.0
Mangel-wurzels	31.46	32.35	42.5
Sugar beets	30.52	32.25	43.5
Red table beets	29.61	32.70	43.0

"The turnips have an injurious flavor, as shown by a score of 38 in a possible 45 for the butter made from them. The mangel-wurzel butter has a score of 42.5, which brings it within the range of fine butters. The sugar beets and red table beets score high, going up among the roots that have no bad volatile acids that injure the flavors of butter."

The results with the 3 different breeds of cows are compared, and representative cows are figured and their records given. The conclusion is that "the Shorthorns and Jerseys gave exactly the same amount

of butter fat per cow per day for the 77 days, 1.08 lbs., and the Holsteins gave 1.07 lbs.," although the Shorthorns and Holsteins gained in live weight, while the Jerseys did not.

Following this trial, the cows were divided into 2 lots, and the roots in the above ration were replaced by their equivalent in dry matter of wheat bran. The ration for 1 lot was wet 12 hours before feeding, and for the other fed dry. This trial lasted 46 days, the lots being reversed once during that time. With the discontinuance of the roots "butter fat decreased, more pounds of dry matter were required to make a pound of butter fat, and the cows did not gain in weight during the 46 days. . . . The difference between the 2 lots is not striking. There is a small percentage in favor of the wet feed."

At the conclusion of the above trial the cows were turned to pasture, and some observations made on the effect of adding bran to the pasture, "which indicates improvement over yield on grass alone."

Annual report for 1894–'95 of the dairy and bacteriological division of the experiment station and dairy school at Kiel, H. WEIGMANN (*Jahresber. Schles. Holst. Landw. Generalvereins, 1895; abs. in Milch Ztg., 25 (1896), Nos. 34, pp. 544, 545; 35, pp. 561, 562*).—This contains articles on (1) the best method for securing an average sample of milk for fat determination;[1] (2) experiments in souring cream with lactic acid;[2] (3) experiments on the effect of distillery refuse (slump) on yield and qualities of the milk; (4) experiments on the effect of peat-molasses feed on the yield and fat content of milk;[3] (5) method for extracting fat from cheese for the purpose of examining and testing the same for admixtures;[4] (6) continuous examination of the milk of the cows in the experiment stables; (7) weekly tests of newly purchased cows, and tests to control the operations of the experimental creamery; and (8) experiments in fattening calves with skim milk; together with the financial record of the creamery and cheese factory, including the profits of making cheese.

In the abstract only the third and eighth articles and the financial record are treated. In the experiment with distillery refuse, 4 cows were fed 24 kg. of rye slump daily, it being added to the regular ration of 2 cows, and fed in place of 3 kg. of wheat bran in case of the other 2. In the former cases it appeared to increase the yield of milk, and in the latter to diminish it. There was no apparent effect on the fat content in any case. The bacteriological examination showed great similarity in the flora of the dung of all the cows before feeding slump. The flora was very different after the slump was fed, although still quite uniform for the different cows. No connection could be traced between the flora of the milk and that of the dung.

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[1] Milch Ztg., 24 (1895), p. 716 (E. S. R., 7, p. 807).
[2] Milch Ztg., 24 (1895), p. 383.
[3] Landw. Wochenbl. Schles. Holst., 1895, p. 150.
[4] Milch Ztg., 24 (1895), p. 729 (E. S. R., 7, p. 555).

Methods for rendering cows' milk more nearly like human milk, BACKHAUS (*Jour. Landw., 44 (1896), Nos. 3, pp. 279–298; 4, pp. 299–309*).—This article treats at length the composition and chemistry of cows' milk and human milk, and the methods which have been suggested for treating cows' milk so as to make it more nearly resemble human milk in composition and general effect, dividing these methods into 11 groups. The author describes a new method devised by himself, which consists in removing the cream from whole milk by separator and treating the skim milk with a mixture of rennet, trypsin ferment, and sodium carbonate at 40° C. for 30 minutes. This changes a part of the casein, giving 1.25 per cent of soluble albumen, and curdles the rest of the casein. The heat is then increased to check the action of the ferments, the curdled casein removed by straining, sufficient cream of the right concentration added to give 3.5 per cent of fat and 0.5 per cent of casein, and about 1 per cent of milk sugar is added. The preparation is then pasteurized.

The ferments used are supplied in powdered form, and it was found that mixtures of the rennet, trypsin, and sodium carbonate could be kept for several weeks without any particular detriment. The proportions of the mixture must be determined experimentally for the skim milk of different herds, so as to furnish the products (soluble albumen and casein) in the right proportion. The treatment diminishes the ash, but makes it nearer in amount to that of human milk.

As to the digestibility of milk prepared in the above way, the trypsin whey gave the biuret reaction for peptones, while, as is well known, common milk contains no peptone; and a number of experiments with Stutzer's method of artificial digestion showed 91.5 per cent of the proteids in the prepared milk to be digested, on an average, while the average was 87.22 per cent of those in a cream mixture of like albumen content, and 75.175 per cent of those in whole milk. However, there were quite considerable differences between the results of separate trials.

The prepared milk has been tried on a large number of children with good success thus far, and is being made at several creameries on a commercial scale.

Report for 1895 of the municipal laboratory for examination of foods and condiments in Nuremberg, KÄMMERER (*Chem. Ztg., 20 (1896), No. 78, pp. 758, 759*).—The examination of beers, butter, oleomargarin, milk, vinegar, honey, flour, mineral waters, etc., are briefly reported upon. Fifty-two samples of butter were examined. The acidity of the butter ranged from 1.66 to 21.4, and averaged 10.5; the acidity of the butter fat ranged from 1.08 to 20.75, and averaged 7.55; and the Köttstorffer saponification equivalent of the butter fat ranged

from 220.7 to 232.6, averaging 225.3. The range of these samples in composition was as follows:

Range in composition of butter samples.

	Highest.	Lowest.	Average.
	Per cent.	*Per cent.*	*Per cent.*
Water	16.45	6.330	9.920
Fat	91.75	82.160	87.550
Proteids	3.74	.240	1.230
Milk sugar	1.40	.030	.530
Ash	.25	.035	.176

The high average acidity is attributed to the fact that a large proportion of the samples were country butter.

The cause of the curdling of milk in thunderstorms, H. GERSTMANN (*Electrotech. Ztschr., 1896, p. 74; abs. in Milch Ztg., 25 (1896), No. 37, p. 589*).—The statement is made that every flash of lightning causes an induction current in the milk, which decomposes the constituents soluble in water. The acid suddenly developed by this curdles the milk. In support of this view the rapidity with which milk often curdles is noted. No experimental evidence is presented.

Studies on milk preservatives, J. B. WEEMS and W. H. HEILEMAN (*Iowa Sta. Bul. 32, pp. 499–504*).—In numerous trials a 40 per cent solution of formic aldehyde was compared with corrosive sublimate, potassium bichromate, and no preservative. In each case 400 cc. samples were used and varying amounts of the preservative formic aldehyde were used alone and mixed with methyl alcohol. The number of days before the samples curdled was noted and frequent tests were made with the Babcock test for fat. The latter showed no loss of fat due to the preservative. The results of the trials are tabulated. A summary is given below.

"(1) From the above experiments there is reason to believe that 'formic aldehyde 40 per cent' promises to become a preservative for composite samples; while indicating that it has good preserving powers, it has in its favor the following facts: It is not poisonous, though it may be disagreeable if taken into the mouth in its strongest form. It is readily measured and handled.

"(2) One cubic centimeter gives promise to be sufficient to preserve the usual quantity for the time that a composite sample is usually kept at ordinary temperatures, while 2 cc. insures the sample during very warm weather.

"(3) The condition of samples with formic aldehyde 40 per cent appears to be much better for testing than those preserved by other substances. In some cases the casein appears to be less readily soluble in the acid, but this is during the first portion of the experiment, while after keeping for some time this disappears and then there is a favorable comparison with the other samples."

Milk testing, C. L. PENNY (*Delaware Sta. Rpt. 1895, pp. 199–206*).—The difference between paying for milk by weight and by test is illustrated by the record of a creamery in the State for the month of December, 1894. In this the milk is valued at $1.034 per 100 lbs. and the fat at

27.3 cts. per pound. The amount to be paid each of the 49 patrons on the 2 bases is shown, together with the gain or loss from paying by test.

"It appears that in consequence of the change from the old basis to the new, or 'test,' basis, 31 persons gained, in the aggregate, $48.11; that 18 persons lost, in the aggregate, $48.45, and that the creamery pays practically the same aggregate sum for the milk received. The gains and losses fail to balance completely because of small fractions not counted. This means that over $48, or more than 4 per cent of the month's business, is taken from people to whom it is justly due and paid to people to whom it is not due. Many samples of milk are so near to the average 'test,' in this case 3.787 [per cent], that they neither gain nor lose materially. In the present instance one half of the persons gain or lose less than a dollar. Were all samples thus near the average it would make but little difference on which of the 2 bases the payment might be made. But with the better or poorer grades of milk the difference becomes more considerable, in one case over 23 per cent of the true value of the milk."

Reference is made to the confusion which has arisen from expressing the result of the test in terms of butter in some cases instead of in fat. For instance, a sample of milk containing 4 per cent of fat is reported by one creamery as testing "400" and by another as testing "444." While in reality the tests are identical, the one being fat and the other butter, this is not understood by the producer, and it is often impossible for the station to say, when appealed to, whether the "test" is too low or too high because it is not defined and may mean either fat or butter. "Again, where the creamery reporting the test in butter offers 20 cts. per pound, the creamery reporting the test in fat can offer 23 cts. per pound, and still actually pay a little less. . . . The test should uniformly designate the number of pounds of fat in 100 lbs. of milk."

The author also points out 2 possible errors in operating the Babcock test, namely, inaccuracy in the calibration of the test bottles, and the temperature at which the fat column is measured. Out of one lot of 57 test bottles bought by the station, 28 bottles, or 49 per cent, were found to have an error greater than 0.1 per cent; and out of a second lot of 59 bottles, 25, or 42 per cent, had a similar error.

"About 7 per cent of the entire lot had an error exceeding 0.2 per cent. These errors do not indicate carelessness on the part of the maker, as it is a difficult thing to attain greater accuracy without a considerable increase in the cost of manufacture; but they do show conclusively that the same customer's milk ought not to be tested repeatedly in the same bottle."

As to the effect of the temperature at which the fat column is read off, the variations in the reading of a 4 per cent milk at temperatures from 15 to 100° C. are given, together with the excess or deficit at temperatures above or below 55° C. (131° F.), assumed to be the temperature at which the fat is normally read; and the results are presented of a number of trials showing the rapidity with which the column of fat in the narrow neck of the bottle cools off in the air. For instance,

with an initial temperature of 96° C. and a room temperature of 31° C. (87.8° F.), the column had cooled to 74° C. in 1 minute, to 60° in 2 minutes, to 54° in 3 minutes, and to 42° in 6 minutes.

"With somewhat rapid working a bottle might be taken from the steam centrifugal machine, where such is used, and read at 80°; on the other hand the last bottle of a series of 10 or 20 might cool by standing down to 45°, or in cool weather lower. These extremes would make a difference in the results of 0.13 per cent, equivalent, if constant, to 47 lbs. of butter-fat or $9.40 on the yearly business assumed above—36,000 lbs. of milk. Now this difference may easily be constant and doubtless it often is so. Where each person has the same bottle it is natural to read in a uniform order, so that out of the 10 or 20 bottles whirled at the same time the first bottle will usually be the first read and some other one will usually be the last read, according to the series. It is evident that this is a material injustice. It is to be obviated by reading the bottles in a uniform order, giving each person a different bottle for his successive tests."

Butter flavor, G. L. McKay (*Iowa Sta. Bul. 32, pp. 470–485*).—Experiments were made during the winter to study the effect on the butter flavor of different methods of treatment of the cream, and of ripening the cream with different kinds of "starters." In the majority of cases the milk was that furnished by the patrons of the college creamery. This was separated at the creamery. The butter was made under well-defined conditions, and was scored by 2 or 3 persons on a scale of flavor 450, grain 300, color 100, salt 100, and package 50. In scoring the butter sent away from the station a somewhat different scale was used, but in stating the results these have been calculated to the above scale.

In one series Conn's Bacillus 41 was compared with buttermilk as a starter, and in another series the same was compared with skim milk. The results of these trials are summarized below:

Comparisons of Conn's Bacillus 41 with buttermilk and skim milk "starters."

Starter.	Acidity of cream.[1]	Temperature of churning.	Time occupied in churning.	Fat in buttermilk.	Flavor of butter.[2]		Grain of butter.[3]	
					McKay.	Moore.	McKay.	Moore.
		Deg. F.	*Minutes.*	*Per cent.*				
Conn's Bacillus 41	35	56	30	0.1	415	410	300	295
Buttermilk	34	56	33	.1	400	400	300	300
Conn's Bacillus 41	34½	55	30	Trace.	405	395	300	300
Skim milk	35	54	30	.1	410	410	300	295

[1] Cubic centimeters of deci-normal alkali required to neutralize 50 cc. of cream.
[2] On basis of 450 for perfect.
[3] On basis of 300 for perfect.

Several trials were made in which a starter of pasteurized cream was used in comparison with Bacillus 41, stirring the cream during ripening in some cases and in others not stirring; and in other trials Bacillus

41 was compared with no starter. The results of these trials are given below:

Comparison of Conn's Bacillus 41 with pasteurized cream and with no starter.

Starter.	Acidity of cream.	Temperature of churning.	Time occupied in churning.	Fat in buttermilk.	Flavor of butter. McKay or Barber.	Flavor of butter. Moore or Morin.	Grain of butter. McKay or Barber.	Grain of butter. Moore or Morin.
		Deg. F.	*Min.*	*Per cent.*				
Conn's Bacillus 41	36.5	56	25	0.05	435	430	300	300
Pasteurized cream	35.5	56	25	.05	425	420	300	300
Conn's Bacillus 41	35.5	56	25	.10	420	414	295	290
Pasteurized cream	38.0	56	27	Trace.	425	423	300	300
Conn's Bacillus 41 (not stirred)	37.0	53	33	Trace.	400	396	300	300
Pasteurized cream (not stirred)	36.0	53	35	Trace.	400	396	300	300
Conn's Bacillus 41 (not stirred)	36.0	56	25	.0	420	423	300	280
Conn's Bacillus 41	36.0	55	30	Trace.	423	423	280	280
No starter	36.0	60	20	.15	423	414	295	280

One hundred gallons of cream was divided into 4 equal parts and ripened with buttermilk 48 hours old, using from 3 to 6 qt. of starter in the separate cases. The acidity ranged from 31 to 36, with the amount of starter used. The principal difference was in the flavor of the butter.

"The cream for the above lots of butter all had that thick, granular appearance that is so much desired by some makers before churning; yet No. 4, where the acidity was 36, scored 3 points more in flavor than No. 1 when the acidity was 31."

The effect of quick ripening with frequent stirring but without starter was tried on milk which was 3 days old before it was separated, using 3 different lots. The acidity was 35, 36, and 37, respectively. The flavor of the butter improved with the acidity.

The effect of cabbage and turnips on the flavor of butter was studied in the milk of the college herd. The results of these experiments are tabulated.

"In the first series of experiments cabbage was fed. The milk was so very disagreeable that the man separating had put it to one side as unfit to use, and after it was separated the cream seemed to still retain that peculiar odor; also in the butter the cabbage flavor predominated over the fine aroma common to good butter. However, where the cream was pasteurized the flavor of cabbage seemed to be entirely eradicated, and the butter was of fine quality.

"We pasteurized by putting the cream in a can and immersing it in hot water where live steam was present, bringing the temperature of the cream up to 160°, stirring continually to prevent it from scorching, and keeping it at the above temperature for 20 minutes, then cooling back to a temperature of 60° and applying a starter, at the rate of 4 per cent. . . .

"On December 20 the second series of experiments was commenced. Turnips were now fed to the cows. The milk was very much tainted with their odor; also the cream and butter when the cream was not pasteurized. . . .

"It would seem where cows are fed on foods largely charged with volatile acids, such as cabbage, turnips, onions, or leeks, that good butter can not be made unless the cream is pasteurized."

In 2 experiments a part of the cream was frozen and kept in this condition from 10 to 12 hours, when it was thawed out and ripened. In the first experiment buttermilk was used as a starter, and in the second no starter was used. The results with the frozen and unfrozen cream are summarized below:

Butter made from frozen and unfrozen cream.

Treatment of cream.	Starter.	Acidity of cream.	Temperature of churning.	Time occupied in churning.	Fat in buttermilk.	Flavor of butter.		Grain of butter.	
						McKay or Morin.	Barber.	McKay or Morin.	Barber.
			Deg. F.	*Min.*	*Per cent.*				
Frozen	Buttermilk	35	56	28	0.1	405	414	300	280
Not frozen	do	32	56	30	.1	410	414	300	280
Frozen	None	34	54	32	None.	405	414	280	270
Not frozen	do	33	54	30	Trace.	405	414	280	270

Two experiments were made in which the cream from fresh cows and from "strippers" was compared. In the first experiment no starter was used, and in the second sour skim milk was used. The difference between the butter from the 2 lots of cream was almost entirely in flavor. Some of the scorers scored the butter from the strippers 1 or 2 points higher than that from the new-milch cows.

Some general deductions from the above experiments are quoted below:

"Using 50 as a basis for perfect on flavor, the score by the 3 scorers, not including the writer, on the 7 lots where the acidity was from 36 to 38 and the cream ripened at a temperature above 70 degrees [averaged], 47.28.

"In 7 more lots of the same experiment where the acidity ranged from 31 to 35, the average score by different scorers, on the same basis, was 44.92, or a difference of 2.36 in favor of high acidity. During the latter part of the experiments, some of the butter was overworked to see if it would have any effect on the flavor. Some lots were worked for 10 minutes with no bad results, except injuring the grain.

"It would seem from above experiments that the right degree of acidity largely governs the flavor of butter, all other conditions being favorable.

"Another essential feature in making good butter is that the cream should be frequently stirred during the ripening process, as many of the lactic-acid germs are aërobic and require free oxygen. Where the cream is warmer than the surrounding atmosphere odors are given off, where the cream is cooler odors are taken on. We have found the best results to be obtained by quick ripening with frequent stirring. Our highest flavored butter was produced when the acidity was about 37 and the cream ripened at a temperature above 70°. . . .

"It was found when the cream was ripened to an acidity above 40 that it took on a bitter flavor. The same results were noticeable when the cream was ripened for a long period at a low temperature, without much stirring. Low temperatures seem to be favorable to the growth of germs that impart a bitter flavor to cream."

The Ennsthaler cow, F. KALTENEGGER (*Wiener landw. Ztg., 1896, Aug. 15; reprinted from Milch Ztg., 25 (1896), No. 35, p. 555, fig. 1*).

"Astor," a feeding stuff for cows, E. POTT (*Oesterr. Molk. Ztg., 25 (1896), No. 33, p. 525*).—The constituents and the composition of this commercial feed are given, together with feeding trials with several cows. The latter indicated that the material increased the flow of milk, temporarily at least.

Feeding of milk cows, J. GESCHÉ (*Rev. Agron., 5 (1896), No. 1, pp. 42–50*).—Experiments were made with milch cows to compare the ration ordinarily fed in the region, having a nutritive ratio 1:8.1 with two other rations having a nutritive ratio 1:6.8 and 1:4.9. The ration with a narrow, nutritive ratio gave the most satisfactory returns.

The effect of work or of motion of cows on their milk production (*Milch Ztg., 25 (1896), No. 37, pp. 585, 586*).—A review.

The working of cows, O. STILLICH (*Die Arbeit der Kühe. Leipsic: Hugo Voigt, 1896, pp. 62; abs. in Milch Ztg., 25 (1896), No. 34, p. 545*).—A review of the literature on the effect on the yield and composition of the milk of using cows as draft animals, and an account of experiments on this subject with 2 cows.

A new method for rendering cows' milk more similar to human milk, BACKHAUS (*Milch Ztg., 25 (1896), No. 33, pp. 522–525*).—A shorter account of the method described elsewhere (p. 530).

The nature of the poisonous action of peptonizing bacteria in milk, A. LÜBBERT (*Ztschr. Hyg., 22 (1896), p. 1; abs. in Chem. Ztg., 20 (1896), No. 66, Repert., p. 207*).

Milk "vegetable," E. SPAETH (*Pharm. Centralhalle, 17 (1896), p. 542; abs. in Chem. Ztg., 20 (1896), No. 78, Repert., p. 243*).—Analyses of this commercial condensed product.

The radiator vs. the separator of De Laval (*Milch Ztg., 25 (1896), No. 25, pp. 393–395*).

The present status of the milk control in the principal cities of Germany, H. SCHROTT (*Milch Ztg., 25 (1896), Nos. 38, pp. 601–604; 39, pp. 618–620; 40, pp. 634–637*).

Milk inspection (*Diet. and Hyg. Gaz., 12 (1896), No. 12, pp. 774, 775*).—In an article quoted from the *Pacific Medical Journal* the need of thorough inspection of cows and their surroundings is pointed out.

Butter making in Australia (*Milch Ztg., 25 (1896), No. 25, p. 395*).—A descriptive article.

Refrigerator storage rooms on steamships for transporting butter (*Milch Ztg., 25 (1896), No. 37, pp. 588, 589*).

The exportation of butter to China, C. BOYSEN (*Milch Ztg., 25 (1896), No. 35, pp. 553, 554*).

STATISTICS.

Crop reports for September, October, and November, 1896 (*U. S. Dept. Agr., Division of Statistics Rpts. (n. ser.) 141, pp. 7; 142, pp. 7; 143, pp. 4*).—These include the usual notes and summaries of crop conditions, with reports from the European agent.

Crops and live stock in Ontario, 1896 (*Ontario Bureau of Industries Bul. 60, pp. 16*).

Statistics of Ontario (*Ontario Bureau of Industries Bul. 59, pp. 24*).—Annual production 1891–'95 (with averages for 1882–'90 and 1882–'95), of fall and spring wheat, barley, oats, rye, peas, buckwheat, beans, potatoes, mangel-wurzels, carrots, turnips, hay and clover, and corn; numbers and values of horses, cattle, sheep, hogs, and poultry; statistics of cheese factories, and data relating to farm property, mortgages, and taxes.

Proceedings of the ninth annual convention of the Association of American Agricultural Colleges and Experiment Stations (*U. S. Dept. Agr., Office of Experiment Stations Bul. 30, pp. 100, dgms. 3*).—This is the proceedings of the convention

held at Denver, Colorado, July 16-18, 1895. In addition to the general business and discussion, the following papers are given: "Methods of instruction in teaching agriculture," T. F. Hunt; "Permanent elements in experiment station work," A. C. True; "What studies should be embraced in the four-year Bachelor of Science course?" A. Ellis; "How shall we teach horticulture?" W. R. Lazenby; "The distribution of salts in alkali soils," E. W. Hilgard; "Some undefined duties and methods of station horticulturists," F. W. Rane; "Cheese-curd inflation: its relation to the bacterial flora of foremilk," H. L. Bolley; "Form, size, arrangement, and treatment of plats in field experimentation," W. C. Latta; "Methods of plat experimenting," W. M. Hays, and "Late progress in soil analysis," E. W. Hilgard. An account of this convention has already been given (E. S. R., 7, p. 169).

Index of Alabama College Station bulletins (*Alabama College Sta. Index, Vols. II, pp. 20; III, pp. 24*).—These contain subject lists of the 58 station bulletins issued between July, 1888, and August, 1894, and a combined subject and author index to the matter therein contained.

Report of treasurer of Delaware Station, 1895 (*Delaware Sta. Rpt. 1895, pp. 4, 5*).—A financial statement for the fiscal year ending June 30, 1895.

Report of the chairman of Minnesota Station, 1895 (*Minnesota Sta. Rpt. 1895, pp. IV-XIV*).—This includes a list of the bulletins issued during the year, remarks on general progress of station, and a financial statement for the fiscal year ending June 30, 1895.

Report of director and treasurer of Mississippi Station, 1895 (*Mississippi Sta. Rpt. 1895, pp. 1-6*).—This includes a financial statement for the fiscal year ending June 30, 1895, and report by the director indicating lines of work pursued and giving a list of the bulletins issued by the station during the year.

Fifth Annual Report of Washington Station, 1895 (*Washington Sta. Rpt. 1895, pp. 29*).—Reports by director and heads of departments and a financial report for the fiscal year ending June 30, 1895.

The imperial agricultural-chemical experiment station at Vienna, W. BERSCH (*Chem. Ztg., 20 (1896), No. 63, pp. 616-618, figs. 3*).—Plans and description of the new station building.

Sixty-eighth congress of the Association of German Naturalists and Physicians (*Chem. Ztg., 20 (1896), Nos. 78, pp. 757, 758; 79, pp. 765-767; 80, pp. 781-790; 81, pp. 791-801; 82, pp. 805-811; 83, pp. 821-823; 84, pp. 839-847*).—A quite full account is given of the proceedings of the various sections of this association at the meeting at Frankfort on the Main, September 21 to 26, 1896. The following papers, among others, were read: The results of new investigations on upland moor soils—(1) effect of the water content on the yield, (2) relations of phosphoric acid in such soils, and (3) effect of deepening the surface soil on the yield and the lasting effect of manuring, by Dr. Tacke; Results of eight years' experience with the green manuring system without cattle, by G. Dehlinger; Dependence of moss and meadow moors on the lime supply of the subsoil, by Drude; New observations in vegetation experiments, by Wilfarth; Some recent investigations concerning soil inoculation with pure cultures of tubercle bacilli for culture of legumes, by F. Nobbe (see p. 469); Preservation of blood with molasses by the method of Friedrichs and Claussen in Copenhagen, by H. Fresenius; The advantages of raw goat's milk as food for children, by O. Schwartz; A simple method for the determination of zinc in foods, by Janke; The importance, production, examination, and inspection of Hungarian wines, by Bein; Importance of salts in nutrition, by Köppe; Investigations on the determination of the fat content of milk, by H. Fresenius (satisfactory test of Babcock and Gerber methods in comparison with gravimetric); and Determination of boric acid, by Schneider.

NOTES.

ALABAMA COLLEGE.—A biological survey of Alabama has been organized and put in operation. The survey will be carried on under the auspices of the college, and will be made by specialists at that institution in the various lines of biological investigation. It will have for its object the study in field and laboratory of all plants and animals occurring in the State. In connection with the survey an exchange bureau has been founded, from which duplicate specimens of plants and animals (especially insects) will be distributed. Correspondence relative to this work should be addressed to the Alabama Biological Survey, Auburn, Alabama.

ARIZONA STATION.—M. G. Samaniego, of Tucson, has been appointed a member of the board of control of the station, vice J. G. Hilzinger, of Tucson. Harry G. Wolfgang, of Leetonia, Ohio, has been made foreman of the grounds at Tucson.

CALIFORNIA STATION.—A. V. Stubenrauch has resigned the foremanship of the Paso Robles substation and has been appointed clerk to the director at Berkeley in place of William Winterhalter, resigned. Farmers' institutes are being held at 50 localities in the State during the months of December to March under the auspices of the College of Agriculture. Dr. J. H. C. Bonte, secretary of the board of regents of the University, died on November 24, 1896.

GEORGIA STATION.—The station is about to undertake investigations and experimental work in irrigation, beet culture, and swine breeding and feeding. The necessary buildings for the latter purpose will soon be provided.

The work of this station has been in progress nearly 8 years, with but one change in the staff, and that was caused by a death.

SOUTH CAROLINA STATION.—W. J. Quick has been elected professor of agriculture in the college and agriculturist of the station.

VERMONT STATION.—D. H. Howe, farm superintendent, has resigned to take effect February 1, 1897, and Cassius Peck, of Brookfield, has been elected as his successor.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vols. I to VII, with indexes; Vol. VIII, Nos. 1–5.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, the Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of Stations and Colleges, 1892; No. 13, Organization Lists of Stations and Colleges, 1893; No. 14, Proceedings of Convention of National League for Good Roads, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of Stations and Colleges, 1894; No. 20, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of Stations and Colleges, 1895; No. 24, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of Stations and Colleges, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University in 1895; No. 33, The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses; No. 34, The Carbohydrates of Wheat, Maize, Flour, and Bread, and the Action of Enzymic Ferments Upon Starches of Different Origin; No. 35, Food and Nutrition Investigations in New Jersey in 1895 and 1896.

Miscellaneous Bulletins.—Nos. 1, 2, and 3, Proceedings of Association of Agricultural Colleges and Experiment Stations, January and November, 1889, and November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates; No. 48, The Manuring of Cotton.

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII No. 7

EXPERIMENT STATION RECORD

WASHINGTON
GOVERNMENT PRINTING OFFICE
1897

U. S. DEPARTMENT OF AGRICULTURE.

Scientific Bureaus and Divisions.

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* Director.
† President of board of direction.
‡ Assistant director in charge.
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‖ Secretary.
¶ Acting director.

EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
WALTER H. EVANS, PH. D.—Botany and Diseases of Plants.
——— ———.—Horticulture.
F. H. HALL—Field Crops.
C. F. LANGWORTHY, PH. D.—Foods and Animal Production.
F. C. KENYON, PH. D.—Entomology.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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BOTANY.

METEOROLOGY.

WATER—SOILS.

FERTILIZERS.

FIELD CROPS.

STATISTICS.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

VOL. VIII. NO. 7.

The Secretary of Agriculture recently transmitted to Congress a report on the work and expenditures of the agricultural experiment stations for the fiscal year ended June 30, 1896. This report, prepared in this Office under instructions from the Secretary in accordance with the act of Congress making appropriations for this Department, contains brief statements and statistics regarding the work and expenditures of each of the stations. The following paragraphs, taken from the introduction to the report, may be of interest, especially in connection with the account of the convention of the Association of American Agricultural Colleges and Experiment Stations given in this number of the Record.

The general causes which have hitherto weakened the operations of our stations have of course still continued to work to their disadvantage, and will undoubtedly hamper them more or less in the years to come. There have, however, been many encouraging indications during the past year that clearer notions of the proper functions of experiment stations as organizations for the application of scientific research to the practical needs of agriculture are beginning to prevail, even in quarters where hitherto there has seemed to be the most misapprehension regarding their rightful work. As new officers are appointed in the stations, there is a closer scrutiny of their previous training and experience as related to the work they are expected to undertake. In securing chief officers to plan and conduct the more important researches there is a growing competition to have the best men. While this is bringing into bolder relief the scarcity of the thoroughly competent material for this purpose, it is stimulating the ambition and activity of station officers, who can now more confidently look forward to a reasonable degree of success if their efforts in agricultural research are strenuous and well directed. We can thus hope that the ranks of well-trained and efficient administrators and investigators will more speedily be filled.

There are evidences that the wisdom of concentrating the work of individual stations on a few subjects which can be thoroughly treated is being more deeply impressed on station managers. During the past year the establishment of substations, to be supported with the national funds, has been stopped, a number of those already organized have been closed, and arrangements are being made to withdraw from others

as fast as the best interests of the work will permit. On the other hand, through the liberality of State legislatures and local communities, some stations have been enabled to wisely extend their operations on the basis of adequate financial support, and in general it may be said that the stations are striving to find out what are the most important agricultural needs of their respective regions which can be aided by scientific research, and are directing their efforts toward supplying these needs in a broad way and for the good of the greatest number.

It is also gratifying to note that the necessity for permanency in the personnel and operations of the stations is being more generally recognized. In some places, it is true, during the past year radical reorganizations of the station staffs have occurred. Here and there changes have apparently been due to political influence or to an unreasonable spirit of restlessness more difficult to account for. These, however, are manifestly the weak spots in our station system. The stations which are doing good work and accomplishing the best results are holding steadily to the lines of work which they have marked out, and are changing their forces only as necessity or good and sufficient reasons compel. As the stations where vacillating policies prevail fall more distinctly behind their fellows, it is to be expected that local pride and the demands of an awakening public spirit will compel a readjustment of their affairs on a proper basis.

On the whole, the station enterprise in this country has enjoyed a year of prosperity. Its work has been regularly pursued, new fields of usefulness have been occupied, much helpful knowledge has been acquired, and a great mass of useful information has been broadly disseminated. On all sides we hear of increased demands from the farmers for the information which the stations have to give. Station officers are constantly being urged and tempted to interrupt the search after new truth in order that they may set forth more clearly and systematically in the language of the people the results of previous investigations in the realm of agricultural science in this country and abroad. It is more necessary now than ever before to urge that the stations be left to carry on their legitimate work of research. As the investigations of the stations develop in thoroughness and complexity, there is increasing danger of failure and disappointment if they are interfered with or diverted. We are glad to be able to say that thus far the station workers have been able to extend their inquiries year by year, while at the same time they have in large degree met the demand for immediately practical information. That the benefits of station work are realized by increasing numbers of our farmers is well shown in the general disposition of the States and local communities to supplement the funds given by the National Government. Wherever stations are doing thorough work there is a rising tide of popular support for their enterprises, and we may confidently expect a greater development of this movement in the not distant future.

TENTH ANNUAL CONVENTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

W. H. BEAL.

Office of Experiment Stations.

The tenth annual convention of the Association of American Agricultural Colleges and Experiment Stations was held at Washington, D. C., November 10–12, 1896. About 140 delegates and visitors were present, representing 38 States and Territories, the Department of Agriculture, and the Dominion of Canada. The States and Territories not represented were Arizona, California, Idaho, Louisiana, Montana, Oklahoma, Oregon, Utah, and Wyoming.

The convention was called to order by the president, S. W. Johnson, of Connecticut, and prayer was offered by R. H. Jesse, of Missouri.

The report of the executive committee, submitted by the chairman, H. H. Goodell, of Massachusetts, reviewed briefly the work of the committee during the year and made a number of recommendations which are noted later in this account.

The treasurer's report was submitted by J. H. Washburn, of Rhode Island. This showed a balance in the treasury of the Association of $475.45. The dues for the next year were fixed at $10 for each member of the Association.

In the absence of the chairman of the section on college work the report of that section was submitted by the vice-chairman, J. E. Stubbs, of Nevada. In this report it is maintained—

"(1) That the higher education, so called, has become absolutely essential to the prosperity and welfare of those who choose agriculture as a business or life calling. . . .

"(2) That the interest in athletic sports, such as football, baseball, and tennis, in our colleges, though but incidental to the life and work of these institutions, has nevertheless an ethical and thereby an educational value which is worthy of high regard."

(3) That the correlation of the subjects of instruction and discipline in colleges of agriculture and mechanic arts is based upon the same pedagogic principles which obtain in the college courses usually termed liberal.

The entrance requirements and number of courses offered in the different institutions are summarized from replies to a circular of inquiry:

"Out of 46 colleges reporting, 30 have preparatory departments, 16 have no sub-freshman classes. In these preparatory schools 10 colleges have a one-year course,

8 have a two-year course, 6 have a three-year course, 1 has a four-year course, and 5 are indefinite, merely reporting a sub-freshman class. . . . Institutions which have no preparatory departments are chiefly the universities in the wealthy and populous States where there are first-class high schools in all the cities and towns. In the newer and less populous States a well-equipped preparatory school of high-school grade with courses of studies covering a period of 3 or 4 years is a necessity and will continue to be a necessity for many years to come."

C. C. Georgeson, of Kansas, presented a report from the section on agriculture and chemistry, in which he summarized the replies to a circular of inquiry sent to the different agricultural institutions of the United States regarding education and experiments in agriculture and chemistry. The data obtained indicate that "63 per cent of the institutions which have agricultural courses in their curricula gave instruction in agriculture and agricultural chemistry in their restricted sense to 3,888 students during the past year."

The 38 experiment stations replying to the circular reported the employment of 153 workers in agriculture, 89 of whom are superintendents or directors and 64 assistants, 100 performing college duties in addition to station work. These 38 stations employ 107 workers in agricultural chemistry, 47 of whom are superintendents or chiefs and 60 assistants, 47 having college work in connection with the station work. A summary of the lines of work pursued at the different stations was also given.

The report of the section on horticulture and botany was submitted by F. W. Card, of Nebraska. Attention was called to the lack of systematic courses of instruction in horticulture in the institutions represented in the Association. Reports from these institutions indicate that horticulture is often taught simply as a business, not as a science. Station work has been devoted mainly to the growing of fruits and vegetables, largely variety testing, although some attention has been given to plant breeding, greenhouse construction and management, the propagation of plants, and crossing. There is a marked tendency, however, to make variety testing and similar work incidental rather than a main feature, and a review of experimental work of the year indicates that the stations are covering a much broader field than formerly and that there is a growing appreciation on the part of the public of these horticultural and botanical investigations.

The report of the section on mechanic arts, by J. W. Lawrence, of Colorado, discussed the character of the courses offered in the various institutions represented in the Association. These were found to vary from those scarcely better than the courses offered in some high schools to those requiring a first-class school training for admission. Many institutions which undertook to raise the courses have been forced to lower them because of the insufficient preparation of students applying for admission, and have attempted to partially overcome the difficulty by the introduction of preparatory and sub-freshman courses. It is insisted that the greatest advantage from the courses

offered in the colleges represented by the Association is obtained by students who have had a broad general education. The attendance on the mechanical courses is good as compared with that in the other departments when separate and distinct courses in mechanic arts are provided. That this separation is desirable is being increasingly appreciated, and there is an evident tendency to raise the course to the highest grade and admit only well-trained students. Reports from the different institutions indicate that the courses are generally being strengthened, equipment improved, and attendance increasing. Experimental laboratories are being introduced.

In the annual address of the president, S. W. Johnson, the extent and importance of agricultural education and experimentation were pointed out and progress made in these lines was reviewed. It was stated that the work of American experiment stations is on the whole "not less efficient and not less useful than that of the Old World." The importance of adapting the work to those who are to be immediately benefited is insisted upon.

"Our duty is to aim as high as possible without overshooting the mark. We can not succeed with instruction that is too purely disciplinary, because our constituents will not relish it. Neither will success be attained by the cramming process. The young pupil and the parent must be brought to see that profitable education demands first of all enlargement of mental capacity as an essential prerequisite to extensive acquisitions of knowledge, and that if a man is well exercised and developed in all around intellectual athletics, his appetite, his digestive and assimilatory powers may be fully trusted to find abundant nourishment and to make rapid and healthy growth."

The speaker advocated some familiarity with the dead languages as a preparation for scientific studies, and commended the introduction of shorter courses in agricultural colleges. He claimed that the teacher should always be a student and if possible an investigator.

"Just as in our colleges of agriculture and mechanic arts we should be careful at the outset to fit discipline and instruction to the actual needs of the students, so in the experiment stations we ought at first to give prominence to those lines of work which our constituencies can most plainly see are to them directly useful, are in fact to them indispensable."

The advantage which the investigator derives from the support of a highly educated constituency and from the introduction of elements of permanency in scientific research was illustrated by the successful work of the German investigators.

"I would urge the younger scientists of our colleges and stations to place themselves, if for but a few months only, under the influence of the great European teachers, and I hold it to be a most worthy use of any fund that may be available to send college teachers and station workers abroad to gather inspiration and finish at the Old World shrines of science. Considered as mere tools our chemists, botanists, and all who adopt college and station duty as life work are worth sending to be sharpened, adjusted, and polished where that business has been transacted longest and most efficiently."

The adoption of a uniform system of publications to be strictly followed by all the stations was advocated. The confusion that results

from the systems of issuing publications followed in some of the stations was clearly brought out and means by which they may be simplified were explained.

The following recommendations of the executive committee were adopted:

(1) That the Association calls the attention of all concerned to the limitations of the franking privilege granted experiment stations. The law is explicit, providing only for the franking of bulletins and college reports containing the annual reports of stations. Great care should be observed by station officers not to abuse this valuable privilege so very necessary to the work of the stations.

(2) That the chairman of the section and the editors of the proceedings of the convention be constituted a committee to pass on the papers from each section, and that the Department [of Agriculture] be urged to print the papers recommended by this committee.

(3) That the station directors drop from their mailing list the names of workers in other stations and depend entirely upon the list furnished at Washington, sending for a fresh copy at the time of issuing each bulletin.

(4) In view of the large and increasing number of measures which are introduced in Congress affecting the interests of the colleges and stations, and the frequent lack of coöperation among those interested concerning such measures, whereby the influence of the Association and the interests it represents are liable to be materially weakened, the committee respectfully recommends that institutions members of the Association and their officers refrain from advocating measures affecting the interests of all until such measures shall have been considered and approved by the Association.

(5) That hereafter no committee acting under the appointment of this Association shall incur any expense without the specific authority of the executive committee.

A committee, consisting of G. W. Atherton, of Pennsylvania; A. Q. Holladay, of North Carolina; and H. H. Goodell, of Massachusetts, was appointed to wait on the War Department and adjust relations between it and the colleges.

Consideration of the formation of a permanent section on irrigation was postponed until the next convention.

A brief report was submitted by the committee on indexing of agricultural literature, appointed at the last convention. In view of the incompleteness of the work and the extensive field to be covered the membership of the committee was increased to 5, and it was instructed to continue the work. The committee consists of A. C. True, of this Office; W. M. Hays, of Minnesota; the librarian (W. P. Cutter) of this Department; H. P. Armsby, of Pennsylvania, and E. Davenport, of Illinois.

The report of the bibliographer was submitted by A. C. True, accompanied by a list[1] of 1,450 books and pamphlets on agriculture and the associated sciences which have appeared within the last four years.

By a resolution offered by G. E. MacLean, of Nebraska, the executive committee was authorized to take steps looking to the adoption by Congress of the metric system of weights and measures.

The amendment to the constitution offered by H. P. Armsby at the

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[1] U. S. Dept. Agr., Office of Experiment Stations Circular 31.

last meeting of the Association, to the effect that "no delegate shall vote in more than one section and each delegate shall when presenting his credentials designate the section in which he intends to vote," was indefinitely postponed.

A report from the special committee on seed testing of the section on horticulture and botany was presented by G. McCarthy, of North Carolina. He reviewed the advance made in seed testing in recent years and called attention to the prevalence of fraud in the seed business. A new form of bacteriological oven, well adapted to use in the germination of seeds, was described. The German methods of testing seeds were declared to be quite satisfactory, and the standards adopted by the United States Department of Agriculture and the North Carolina Station were claimed to have been used with good results. The importance of uniformity of methods in this country was strongly urged.

The following memorial, signed by 37 station directors, was presented:

> The undersigned directors of American experiment stations, recognizing the benefit to be derived to agriculture from an improvement in the quality of seed merchandise and by enabling seedsmen to offer a guarantee of specified quality, request the Association to appoint a committee of experts in seed testing to devise and adopt a standard form of seed-testing apparatus and method of procedure for use in all American stations which shall hereafter publish seed tests, to the end that all such work shall be strictly comparable and that seedsmen may guarantee the quality of their seeds according to the official methods. Said committee to report at the next annual convention.

The following committee was appointed by the president to take charge of the matter: E. H. Jenkins, of Connecticut; G. H. Hicks, of this Department; G. McCarthy, of North Carolina; F. W. Card, of Nebraska. and W. R. Lazenby, of Ohio. (See p. 556.)

A resolution was adopted which recommended a revision to date of the Handbook of Experiment Station Work[1] and the incorporation in it of summaries of the investigations of this Department, and which set forth further that "there is, in the judgment of this Association, great need of a general index of the publications of the Department, and as the preparation of such an index would almost necessarily precede the making of summaries of the Department publications for the Handbook, it is hoped that it will be practicable for the Department to at once undertake the preparation of this index."

The question of the uniform indexing and consecutive paging of station publications was referred to the executive committee, which was instructed either "directly or indirectly, by proper reference to committee, to consider it during the year and report at the next convention such method as may seem practicable."

The privileges of the floor were granted to J. Hamilton, Deputy Secretary of Agriculture of Pennsylvania, who addressed the Association on the need of a systematic and complete course of instruction adapted to the use of farmers, and embracing the latest and best information

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 15.

with regard to their occupation. He suggested that the Secretary of Agriculture be requested "to consider the advisability and propriety of arranging for the editing, under the direction of the National Department of Agriculture, of such a series of books as the necessities of our farming interests seem to require." The suggestions of this paper were referred to a committee of three, consisting of C. W. Dabney, jr., Assistant Secretary of Agriculture; W. H. Jordan, of New York; and W. A. Henry, of Wisconsin, to report at the next convention.

A progress report of the committee on methods of teaching agriculture was presented by A. C. True, of this Office, as secretary of the committee. As the result of a preliminary study of data collected by the committee from the agricultural colleges throughout the country, it appears that "there exists at present in this country no standard for instruction in agriculture. There is a bewildering variety as regards the topics taught, the time devoted to each topic, the order in which the different topics occur in the course, the relative amounts of class-room work and laboratory or practical exercises, etc."

To afford a basis for further discussion of this matter the committee proposed a tentative scheme for the division of what is commonly designated agriculture in courses of study into several distinct branches or subdivisions, and for giving each of these branches a definite name, as follows:

	1. Agronomy, or agriculture (technical).	Climate, soils, fertilizers, and crops—plant production.
	2. Zoötechny, or animal industry.	Animal physiology and animal production.
Agriculture ..	3. Agrotechny, or agricultural technology.	Agricultural industries, *e. g.*, dairying, sugar making.
	4. Rural engineering, farm mechanics, or farm equipment.	Roads, drains, irrigation systems, farm buildings, etc.
	5. Rural economy, or farm management.	General policy of farm management, rural law, agricultural bookkeeping, etc.

Accompanying the report[1] were papers on "Some features of European institutions for agricultural education," by A. C. True, and "Agricultural education in the Scandinavian countries," by F. W. Woll.

C. S. Murkland, of New Hampshire, submitted the report of the committee on entrance requirements, courses of study, and degrees, which was ordered printed. The principal conclusions of this report may be summed up as follows:

(1) That two series of entrance requirements, a standard series and a minimum series, be approved by the Association.

As a standard series of entrance requirements, to be adopted as soon as possible, we recommend the following: Physical geography; United States history; arithmetic, including the metric system; algebra, to quadratics; English grammar and composition, together with the English requirements of the New England Association of Colleges and Preparatory Schools; plane geometry; one foreign language; one of the natural sciences; ancient, general, or English history.

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[1] The report and accompanying papers have been published as Circular No. 32 of this Office.

From a careful examination of the catalogues we believe it to be practicable, either now or in the near future, for these institutions to unite in requiring as a minimum for admission to their lowest collegiate class: Physical geography; United States history; arithmetic, including the metric system; algebra, to quadratics; English grammar and composition, together with the English requirements of the New England Association of Colleges and Preparatory Schools.

(2) That approximately 15 hours be devoted to recitations or lectures each week, for 36 weeks each year; that 10 hours laboratory work or practicums be added.

(3) That the following list of studies be included in every course leading to a bachelor's degree:

	Hours.		Hours.
Algebra	75	Modern languages	340
Geometry	40	Psychology	60
Trigonometry	40	Ethics or logic	40
Physics (class-room work)	75	Political economy	60
Physics (laboratory work)	75	General history	80
Chemistry (class-room work)	75	Constitutional law	50
Chemistry (laboratory work)	75		
English	200	Total	1,285

(4) That the degree of Bachelor of Science be recognized as the standard degree conferred by the colleges of this Association.

The report was adopted with the following prefatory declaration:

That the schemes of studies presented for admission to the colleges and for graduation therefrom are suggestive and tentative, not to be considered as of necessity or binding upon the colleges which may assent to the adoption of said report, and subject, without prejudice as to equal efficiency, to such substitution of other studies of equal and similar educative value for those named in the schemes as the peculiar conditions of the several colleges may make necessary.

This report provoked considerable discussion, the modern languages requirement being especially opposed.

C. W. Dabney, jr., Assistant Secretary of Agriculture, read a paper on "Civil service in the Department of Agriculture,"[1] in which he discussed in detail the growth in recent years and the present condition of civil service in this Department. All employees above the grade of unskilled laborer or worker, except the Secretary, Assistant Secretary, and Chief of the Weather Bureau, are now in the classified service. A plan of examinations for establishing lists of eligibles suited to the requirements of the Department was outlined. The main object of this plan is to afford opportunities for graduates of agricultural colleges and technical schools to enter, through competitive examinations, not only the higher positions, but also to receive "temporary employment in the minor positions of the Department where they would have opportunities for observation and study which would fit them for better work" and ultimately for promotion to the higher grades.

The need of an administrative officer who could give continuity to the scientific work of the Department was pointed out. The Secretary of Agriculture has recommended to Congress the appointment of an additional officer in the Department "to be known as director-in-chief

[1] U. S. Dept. Agr., Office of Experiment Stations Circular 33.

of scientific bureaus and investigations, who shall continue in office during good behavior, and perform such duties as the Secretary may assign him."

In furtherance of the last suggestion, C. D. Smith, of Michigan, introduced and the Association adopted a resolution declaring "that the creation of the proposed office and the appointment thereto of a broadly educated scientific man, who shall hold office during good behavior, would be of the highest value to the cause of scientific agriculture in the continuity of purpose and harmonization of operations that should result from the labors and influence of such an officer."

A committee consisting of G. W. Atherton, of Pennsylvania; J. E. Stubbs, of Nevada; J. H. Smart, of Indiana, and H. H. Goodell, of Massachusetts, was appointed "to wait upon President-elect McKinley and present to him the importance of such an organization and administration of the Department of Agriculture as will give unity and permanence to all its scientific work and keep that work free from political influence."

J. H. Brigham, of Ohio, the Master of the National Grange, was given the privileges of the floor, and expressed briefly his own and the Grange's interest in the work of the institutions represented in the Association, and urged coöperation between all organizations having as an object the advancement of agriculture.

The question of changing the name of the Association provoked a lengthy discussion, the outcome of which was the rejection of the name proposed by the committee on this matter.

A resolution, reported by W. B. Alwood, of Virginia, from the section on entomology, advising the different institutions represented in the Association to take steps to secure legislation designed to repress insect pests, especially the San José scale, was referred to the executive committee, which reported that it deemed it "inexpedient as a matter of general policy for the Association to attempt to influence legislation in the various States." This recommendation of the committee was approved (see p. 556).

W. T. Harris, United States Commissioner of Education, addressed the convention on agricultural education, confining his attention especially to the report of the committee on entrance requirements, courses of study, and degrees. He commended the prominence given to English branches in that scheme. He maintained that the studies should be arranged with the object of taking the boy from the farm, making him a man of directive power, and putting him back on the farm. He considered it fortunate that instruction in mechanic arts was associated with training in agriculture in these colleges. Instruction in agriculture labors under the great disadvantage of the lack of pedagogic facilities.

The committee appointed at the last convention submitted through H. E. Alvord a report embodying a codification of all "the resolutions

and declarations of previous meetings of the Association concerning uniformity in action on the part of colleges and stations in matters of common interest." The report was referred to the executive committee to be edited and printed and submitted to the next annual convention.

A committee of three was appointed to revise the constitution of the Association and report at the next meeting. This committee consists of J. H. Smart, of Indiana; H. E. Alvord, of this Department; and H. H. Goodell, of Massachusetts.

The committee on nomenclature appointed at the last convention submitted a report defining a number of terms used in connection with field crops, breeds and breeding, feeding stuffs, animal chemistry and physiology, dairying, horticulture, and entomology. Objections were raised regarding a number of the terms included in the report, and these were referred back to the committee for further consideration and report at the next meeting. The committee is as follows: H. P. Armsby, of Pennsylvania; E. H. Jenkins, of Connecticut; S. M. Tracy, of Mississippi; C. P. Gillette, of Colorado; and A. C. True, of this Office.

On invitation of the Association, Senator Morrill, of Vermont, attended one of the sessions of the convention, and received a most cordial welcome. Subsequently the convention adopted resolutions congratulating him upon his recent reëlection to the Senate, and upon his long and distinguished public services.

Resolutions of regret on the death of Edwin Willits, Ex-Assistant Secretary of Agriculture, were also adopted, and a telegram of sympathy was sent to Ex-Congressman W. H. Hatch, of Missouri.

The convention in a body attended a session of the National Grange, which was holding its convention in Washington at that time; and by special appointment the members of the Association were received by the President of the United States.

The Association received invitations to hold its next annual convention at Minneapolis, Minnesota; Geneva and Ithaca, New York; and Wooster, Ohio.

The officers of the Association for the ensuing year are as follows:

President, G. T. Fairchild, of Kansas; vice-presidents, M. H. Buckham of Vermont, James Wilson of Iowa, J. M. McBryde of Virginia, A. Kingsbury of New Hampshire, and J. E. Stubbs of Nevada; secretary and treasurer, J. H. Washburn, of Rhode Island; executive committee, H. H. Goodell of Massachusetts (chairman), A. Cope of Ohio, H. C. White of Georgia, and T. J. Burrill of Illinois; bibliographer, A. C. True, of Washington, D. C.

Section on agriculture and chemistry.—Chairman, W. H. Jordan, of New York; secretary, H. J. Waters, of Missouri.

Section on botany and horticulture.—Chairman, P. H. Mell, of Alabama; secretary, L. C. Corbett, of West Virginia.

Section on college work.—Chairman, H. C. White, of Georgia; secretary, E. Davenport, of Illinois.

Section on entomology.—Chairman, A. D. Hopkins, of West Virginia; secretary, M. V. Slingerland, of New York.

Section on mechanic arts.—Chairman, C. S. Murkland, of New Hampshire; secretary, F. P. Anderson, of Kentucky.

MEETINGS OF SECTIONS.

SECTION ON COLLEGE WORK.

The sessions of the section on college work were entirely devoted to papers and addresses on the question "What shall be taught in our colleges of agriculture?" and on "The exodus from the farm."

G. T. Fairchild, of Kansas, stated that the object of the agricultural colleges should be to diffuse their influence as widely as possible among the farming element, since they must look for their strongest support among educated farmers. The courses of such colleges should be truly educational, introductory rather than exhaustive, and should be adapted to students of different aptitudes. He gave the following brief outline of the leading features of a course leading to the degree of Bachelor of Science: (1) A good English foundation, (2) a full outline of mathematics as applied to some quantitative science, (3) the sciences introductory to agriculture, (4) complete and exact expression, and (5) manual dexterity.

H. H. Goodell, of Massachusetts, outlined and discussed the courses of study pursued at the Massachusetts Agricultural College, explaining that English was the foundation and framework, and that compulsory manual training had been discarded in that institution.

H. J. Waters, of Missouri, maintained that no uniform system is practicable, and that the greatest educational advantage will be derived from the study of the practical application of the sciences of agriculture. For this reason technical training was advocated.

H. C. White, of Georgia, pointed out the impracticability of a uniform system of instruction in agriculture. Local demands and conditions must be met. Pedagogic methods should be followed, but they should be adapted to the main object sought. The professor of agriculture should demonstrate applications of principles. "Readcraft" must precede and accompany "handcraft." He laid down the general propositions, (1) the colleges should be institutions of higher learning, and (2) their courses should be primarily educational and not too technical.

C. D. Smith, of Michigan, thought the agricultural colleges should be colleges in the strictest sense. The courses should be based on a sufficient knowledge of the common English branches and of the details of farm work.

"The college may rightfully teach why we plow, harrow, sow, and cultivate, but it is not a wise use of the valuable time of the students to teach them how to do these things. The entrance examinations should therefore include a test of the ability of the prospective student to perform the details of farm work.

"The course should be so planned as to arouse, in the opening term, a thirst for knowledge in the mind of the student. At the same time his faculties of observation

should be awakened and directed toward the careful examination of the three fundamentals of agriculture—soil, plants, and animals. . . .

"The intimate relation of the scientific principles and facts taught in the laboratories to the work on the farm ought always to be kept clearly in mind."

The courses given at the Michigan Agricultural College were outlined and discussed.

I. P. Roberts, of New York, in discussing the exodus from the farm, showed that improvements in productive facilities had resulted in overproduction, and had thus forced many to seek more remunerative lines of industry. Many young men, also, have left the farm because they found more attractive occupations elsewhere.

"There are now many who occupy the land who must of necessity leave it, since neither by nature nor by training are they adapted to their vocation, and the sooner they leave their unprofitable occupation and enter into something that is more remunerative, and the sooner trained and cultivated farmers own and till the land, the better it will be for all concerned.

"In order to discover the boys who are naturally fitted for rural affairs and train them for their life work, more 'sifting' must be done at an early period of their lives. This naturally begins in the rural school districts. . . .

"To nourish a healthy sentiment for rural life some of the mysteries of rural life must be known. By teaching the elementary sciences as applied to agriculture in the secondary schools throughout the country pupils may be 'sifted' much earlier than at present. . . .

"If somehow we could get clear of the grasping, sordid, money-getting spirit which is so prevalent in all America and learn to prize highly leisure, wisdom, and knowledge, the problem of low prices, overproduction, and exodus from a healthy rural life would be measurably solved."

E. Davenport, of Illinois, maintained that the point is not how many, but who, are leaving the farms. In many instances farmers who have acquired a competence move to the towns and cities to educate their children under the mistaken idea that they there necessarily get better training for future usefulness than in the country district schools. The opening up of vast areas to agriculture and the improvements of farm machinery have driven many into other pursuits. The odium which the city population has attempted to cast on agricultural pursuits has had an influence in the same direction. One result of the exodus from the farm has been an increase of tenant farming, which has worked great injury to farming in general. The agricultural colleges may exert a powerful influence in correcting these evils.

SECTION ON AGRICULTURE AND CHEMISTRY.

In the section on agriculture and chemistry, H. A. Huston, of Indiana, read a paper on "Chemistry for technical and practical students." The ability to read English understandingly and a working knowledge of the principles of physics were stated to be fundamental. Three means of instruction are at the command of the teacher—books, the laboratory, and the lecture. It appears to be the tendency to give too much prominence to the lecture. For the elementary student it should be confined to demonstration of fundamental facts, supplementing the text-book and the student's own experiments in the laboratory. The

proper use of text-books and works of reference should be given more attention, and quantitative relations should be insisted upon early in the course. The course should be shaped with a view to developing the technical sense: that is, the ability to determine the best course of procedure in different cases. When this has been accomplished, the student is prepared to undertake original investigations, but in the beginning these should be simple and of his own choosing, rather than coöperation with the teacher in some difficult and complicated research.

Discussion on the question "What should be an implement test?" was opened with a paper by E. Davenport, of Illinois. He stated the three considerations affecting the value of an implement to be (1) efficiency, (2) draft, and (3) durability. That machine should be considered the best which does the best work under average conditions. In determining the efficiency the quality as well as the quantity of the work should be taken into account, and the durability of the whole machine is to be measured by that of its weakest part. The dynamometer test is the one most frequently applied, but "it can teach us nothing more than the expense of operating, or give indication whether the demand for power will be steady or unsteady, whether it will be easy or hard upon the team. Of all the tests it is the easiest applied, and while valuable it seems that every other consideration is even more valuable." A sharp distinction is drawn between a machine test proper and a field trial. The latter is more valuable because it tests the machine in a great variety of conditions and takes into consideration its natural life. The speaker strongly recommended "the examination of old machines that have been under fair management to discover the parts that are first suffering. This, with a field trial for quality of work and ease of draft, is about all that can be done, and will in most cases constitute a fairly satisfactory test, though greatly inferior to what the companies themselves are doing, for commercial reasons."

The discussion was continued by R. J. Redding, of Georgia, who stated that "(1) it should be an inflexible rule that no machinery or implement or appliance be tested primarily in the interest or for the benefit of competitive manufacturers or dealers; (2) in general, the expediency of a suggested test, with reference to its bearing upon agriculture, should be affirmatively determined upon by the director or other officer in charge of the station, and (3) with few exceptions machinery to be tested should be such as the station is prepared to use regularly, or at least occasionally, in conducting the experiments and investigations in the usual course."

The form in which the results of these and similar tests should be published was discussed by C. S. Plumb, H. J. Wheeler, H. J. Patterson, E. B. Voorhees, R. J. Redding, and James Wilson. The consensus of opinion seemed to be that the essential results of these tests should be given to the public, whether they were of such a nature that they could be used for advertising purposes or not, although great caution should be exercised in the matter.

A paper on "Recent dynamometer tests of broad and narrow tires on different kinds and conditions of roads" was read by H. J. Waters, of Missouri. Numerous tests at the Missouri Station have shown that the draft of the broad tires (6 in.) is very much lighter in nearly all cases than that of the narrow tires ($1\frac{3}{4}$ in.), the difference in their favor ranging from 26 to 120 per cent. In only 2 cases was the draft of the narrow tire lighter, viz, on a clay road, very soft and sticky, with ruts about 18 in. deep full of water, and on a road with loose stones and sand, with water standing on the surface.

C. D. Smith, of Michigan, stated that the results of similar tests at the Michigan Station had confirmed those reported in this paper.

H. J. Wheeler, of Rhode Island, read a paper on "The recognition of the acidity of upland soils as an indication of their need of calcium carbonate," in which he summarized the results of experiments at the Rhode Island Station and in different parts of the State on the influence of lime in connection with other fertilizers, especially nitrate of soda and sulphate of ammonia, on a large variety of field and garden crops grown on well-drained and acid soil. (E. S. R., 7, p. 850.)

D. E. Salmon, of this Department, discussed the "Effect of the tuberculin test upon the dairy." He stated that tuberculin has been found to be a successful diagnostic in the hands of experienced persons when it has not been used at too frequent intervals on the same animal. He discouraged its promiscuous use by buyers of stock. He maintained that it was useless to kill diseased animals and not to disinfect the stables. The work of inspection and disinfection should be done by experienced officials of the State. Methods of disinfection were briefly described. The free use of hot water or steam for this purpose was recommended, although bichlorid of mercury (1 to 1,000), carbolic acid, and sulphuric acid are effective, but must be used with caution.

"Should milk be sold on the basis of quality?" was discussed in a paper by E. B. Voorhees, of New Jersey, who referred to the recent investigations in regard to the quality of milk in cities of New Jersey[1] carried on under the direction of this Office, and gave the results obtained. He considers that the percentage of fat is a safe guide as to the nutritive value of milk, and that if the fat-content standard were adopted the consumer would be protected in the sense that he would receive just what he paid for, and the producer of a high-quality product would get the advantage of a high price, which fairly belongs to him because of the greater cost of producing milk of a better quality.

C. C. Georgeson, of Kansas, followed with a paper on "How shall selling milk on the basis of quality be accomplished in the retail trade?" He recommended that each State enact stringent laws which shall prescribe detailed regulations of such a nature that if they are lived up to they will insure that none but good milk is ever offered for sale in its borders, and enforce them by appointing a dairy and food commission,

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 35.

with a competent and numerous corps of assistants, whose business it shall be to visit every farm from which milk is sold, keep a constant supervision over the health of the cattle, the manner of their feeding, and the handling of the milk until it reaches the consumer, and with adequate penalties for infractions of the law.

The next paper was read by J. L. Hills, of Vermont, on "What is the most profitable way to dispose of skim milk?" He discussed the food value of skim milk and reviewed at some length feeding tests which had been made with skim milk, making a plea for its more extended use as a food. Skim milk is used for three purposes—as a fertilizer, in the arts, and as a food. Its use as a fertilizer was not considered of great importance. It has a fertilizing value of about 10 cents per hundred pounds. The speaker believed that laws which prevented the sale of skim milk should be so modified as to permit the sale of any milk that had its composition guaranteed, and that very stringent regulations should be made regarding the purity of the supply of milk of all sorts. Skim milk is sometimes evaporated and used in the manufacture of feeding cakes, and the speaker believed that this use could be much extended.

The discussion of the question "Can station farms be conducted so as to not unfit them for experimental purposes?" was opened by R. H. Miller, of Maryland, in a brief paper, and was participated in by R. J. Redding and H. J. Wheeler.

The question "How nearly can physical conditions of soil be controlled and methods for the same?" was discussed by M. Whitney, of this Department, who described electrical apparatus of his own invention for determining, by means of electrical resistance of the soil, the amount of moisture in the soil, the temperature at different depths, and the quantity of soluble salts it contains. The apparatus is also adapted to the determination of the progress of leaching in the soil and of the depth to which rainfall penetrates. He stated that several of these instruments are in successful use by farmers.

I. P. Roberts, of New York, described a new dynamometer for use in determining the draft of agricultural machinery.

W. H. Jordan, of New York, briefly discussed "Reforms which should be inaugurated in the methods of making feeding experiments." He classed feeding experiments under two heads—those which are undertaken for the purpose of discovering the fundamental principles of animal nutrition, and those which may more properly be styled tests of theory or experiments as object lessons. The first class is of the greater importance, but a large proportion of the experiments which the stations have heretofore made belongs to the second class. In the speaker's opinion, reform in feeding experiments should come along the line of a closer study of the materials fed and the product obtained and the lengthening of the feeding periods until we are sure that we have established and maintained certain effects from certain rations. The discussion of this subject was participated in by I. P. Roberts, W. A.

Henry, J. B. Lindsey, James Wilson, and C. C. Georgeson. The principal point brought out was that while the value of scientific experiments is unquestioned, many practical experiments which do not lend themselves to scientific accuracy may be conducted with advantage by the stations.

Two papers—(1) "A brief statement concerning our present knowledge of the composition of crude fiber and extract matter," and (2) "The distribution of galactan in agricultural plants and seeds"—were presented by J. B. Lindsey, of Massachusetts. The first discussed briefly the complex character of crude fiber and nitrogen-free extract as reported in analyses of feeding stuffs, and the second reports the determination of galactan in 48 samples of coarse fodder and concentrated feeding stuffs and seeds. This investigation reveals two facts—"(1) that galactan is not nearly so generally distributed as the pentosans, and (2) that it occurs more particularly in leguminous plants and seeds, the non-leguminous plants being comparatively free."

Other papers presented were "Irrigation for Eastern agriculturists," by F. W. Rane, of New Hampshire, "Improvements in laboratory methods of teaching agriculture," by T. F. Hunt, of Ohio, and "Improvements in and further tests of the laboratory methods for teaching agriculture," by C. S. Plumb, of Indiana.

SECTION ON HORTICULTURE AND BOTANY.

In the section on horticulture and botany G. E. Stone, of Massachusetts, read a paper on "Physiological botany in agricultural colleges," in which the development of American botany was discussed. The author claimed that physiological botany is the fundamental basis of agriculture and horticulture, and should follow a comprehensive course in histology. The normal functions of plants must be known in order to recognize many diseased conditions and discover means for their prevention. The author thought physiological botany should have a wider field in the curriculum of every agricultural college and that wherever possible the experiments should have a practical bearing.

The discussion following the reading of this paper brought out the fact that while less physiological botany is taught than was considered desirable, yet the importance of the study is fully appreciated.

A paper on the "Place in the curriculum of botany, time, phase or phases of work, and relation to other subjects," by L. H. Pammel, of Iowa, was read by the temporary secretary, F. S. Earle. The author outlined the botanical course of the Iowa Agricultural College. No botany is required for admission, but it is provided for in required and elective courses, covering a considerable period of the college course. The use of text-books for teaching elementary botany was advised. Laboratory work should be kept under the guidance of assistants or those in charge, and the economic features should be kept in the foreground, while not neglecting the training value of the subject.

The teaching of industrial horticulture in agricultural colleges was

outlined by S. C. Mason, of Kansas. The author thought that industrial horticulture offers great advantages in that it gives manual training and presents unusual opportunities for teaching by advanced students. Such a course should be preceded by some botanical work. The horticultural course in the Kansas Agricultural College was outlined.

The paper on "Laboratory methods in horticulture," by E. S. Goff, of Wisconsin, was read by the temporary secretary. The author outlined the course provided in the University of Wisconsin and gave in detail the laboratory work and implements used.

L. C. Corbett, of West Virginia, read a paper on "Systems of note taking in experimental horticulture." A modification of the loose-slip method of note taking was shown which was claimed to have the advantages of a permanent form for filing and convenient size and shape for field use. The books are so constructed as to admit of the insertion of new slips. The discussion following the paper disclosed about as many systems of note taking as there were persons taking part in the discussion.

A paper by E. G. Lodeman, of New York, on the "Position of botany in horticultural education," was read by L. C. Corbett, in which it appeared that the author considered systematic botany of little importance in horticulture except from a theoretical standpoint. The other fields of botany were given very slight consideration.

Upon motion of L. C. Corbett, of West Virginia, a committee was appointed to consider the question of providing a bureau of plant registration. The committee appointed consisted of L. C. Corbett, of West Virginia; W. A. Taylor, of this Department; L. H. Bailey, of New York; F. S. Earle, of Alabama; and C. H. Shinn, of California. The objects of such a bureau were stated to be (1) to prevent duplication of names and the renaming of old sorts; (2) to form a national herbarium of economic plants; (3) to simplify nomenclature; (4) to aid the student of varieties and variation under cultivation, and (5) to secure to the originator his discovery as is now done for the inventor. It was generally considered that such a bureau should be attached to the Division of Pomology of this Department.

The section appointed a committee on seed testing, consisting of G. McCarthy, of North Carolina; F. W. Rane, of New Hampshire; and G. H. Hicks, of this Department, which was made a subcommittee to the one appointed in general session of the convention (see p. 545).

SECTION ON ENTOMOLOGY.

The sessions of the section on entomology were opened with the discussion of the need of better legislation against injurious insects in the different States (see p. 548). The matter was referred to a committee of three consisting of W. B. Alwood, of Virginia; L. O. Howard, of

this Department, and W. G. Johnson, of Maryland, who reported the following resolutions:

Whereas in consideration of the recent alarming spread of the San José scale in the Atlantic and Middle States, and the further fact that we believe its suppression can only be accomplished by carefully framed laws, which should be enacted in the several States: Therefore be it

Resolved, First. That the section of entomology of the American Association of Agricultural Colleges and Experiment Stations indorses the principle of special legislation for the suppression of this pest.

Second. That a committee of ten be created, with Dr. L. O. Howard, Chief of the Division of Entomology, U. S. Department of Agriculture, as chairman, which shall carefully prepare such memoranda as they deem best in relation to legislation dealing with the pest, and when so prepared this matter shall be submitted to the authorities of the several States concerned for such action as the legislatures thereof may choose to make.

Third. That it is the sense of this section that State inspection for the control and prevention of the dissemination of this pest upon nursery stock is imperative.

In a paper entitled "Notes from Auburn, Alabama," C. F. Baker gave a record of observations on various insects injurious to crops in that region during the past season.

F. A. Sirrine, of New York, read a paper on "Termites (*Termites flavipes*) as a forcing house pest," in which he noted the damage done by these insects to chrysanthemums in a forcing house at Floral Park, New York, during August, 1896, and by *Epitrix cucumeris* to potatoes, and described experiments on the effect of burying the cocoons upon the vitality of *Melittia ceto.*

In a paper entitled "Experiences with white muscardine and the chinch bug," W. G. Johnson, of Maryland, gave a review of observations and experiments on this subject, summarizing with the statement that he recognized the fungus as a facultative parasite and a slight natural reducing agent of insects, but beyond this experience did not lead him to claim for it any economic value whatever. The experience of W. B. Alwood and O. Lugger tended to confirm the conclusions of this paper.

W. B. Alwood, of Virginia, in a paper on the "Dissemination of the San José scale in Virginia," reviewed the history of the dissemination of this insect in that State and reported progress made under State law in its repression.

W. G. Johnson, of Maryland, reviewed the present status of the San José scale in Maryland and gave a brief account of attempts to repress it. He expressed the opinion that the pest could never be completely suppressed on account of its wide distribution and firm foothold in that State, but could be kept in check by persistent and energetic fighting by a thorough and harmonius State organization on the part of the nurserymen and fruit growers.

A paper on "Economic entomology in North Carolina," by G. McCarthy, noted the prevalence and destructiveness of various injurious insects occurring in that region during the past year.

A paper on "Some results of recent studies of grass feeding Jassidæ," by H. Osborn and E. D. Ball, gave more or less detailed notes on some 34 members of this family of insects and discussed methods of repression. It was shown that while the loss from these insects must be enormous, they may to a great extent be destroyed by the use of a tar pan or hopper-dozer. Up to the present time, however, our knowledge of the life histories of the species involved has been too meager to furnish a certain basis for remedial measures. The paper gave the results of studies of the life history of a number of species, the range of their food plants, especially in the larval state, and the study of the specific limits of a large number of species.

A paper on "The use of steam apparatus for spraying" was read by L. O. Howard. After describing a number of machines devised for this purpose since 1882 the opinion was expressed that such apparatus will seldom be constructed by the owners of even large orchards for their own individual use, but that for community orchard work they are valuable and will come more and more into use. They will prove most valuable, perhaps, for spraying shade trees in cities and large towns.

SECTION ON MECHANIC ARTS.

In the section on mechanic arts the first paper read was one by E. Kidwell, of Michigan, entitled "Requirements for the proper government of an educational institution." This paper provoked sharp discussion, the criticisms of governing boards of these institutions being vigorously combated.

A paper on "Some lecture-room experiments in lubrication" was read by A. Kingsbury, of New Hampshire. It was illustrated by means of apparatus and diagrams.

Other papers presented were "The engineering laboratory in its relation to the public," by W. F. M. Goss, of Indiana; "Some road tests with a bicycle dynamometer," by C. A. Perkins, of Tennessee; "The mechanic arts in the schools of the South," by H. C. Powers, of Florida; "Shop training in its relation to engineering courses," by L. S. Randolph, of Virginia; "Education in mechanical engineering and the arts," by R. H. Thurston, of New York.

A report on the efforts made to promote the passage by Congress of the bill establishing engineering experiment stations was submitted and discussed.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

A new method for the determination of sesquioxids in phosphates and superphosphates, VON GRUEBER (*Eine neue Methode für die Bestimmungen der Sesquioxyde in Phosphaten und Superphosphaten. Goslar: J. Jäger & Sohn, 1896, pp. 7; Ztschr. angew. Chem., 1896, No. 24, pp. 741, 742*).—It is stated on the basis of a number of analyses reported that the Glaser method for the determination of sesquioxids in phosphates is sufficiently reliable for ordinary purposes, but it has the disadvantage of not distinguishing between the oxids of iron and alumina. To overcome this objection the author proposes the following method: Mix 10 gm. of crude phosphate or superphosphate in a porcelain dish with 150 cc. of water and 20 cc. of concentrated hydrochloric acid, cover the dish with a watch glass, and warm in a water bath until the phosphates are dissolved. Evaporate to dryness, take up with hydrochloric acid and water, warm until redissolved, and wash into a 500 cc. flask. When cool fill the flask to the mark, mix thoroughly, and filter off aliquot parts for the determinations.

For the determination of alumina, heat 50 cc. of the filtrate (corresponding to 5 gm. of substance) in a 200 cc. flask, add 20 per cent sodium hydrate solution until a slight precipitate appears, then add 30 cc. of the soda solution, heat to boiling, and allow to stand for 10 minutes in a warm place, with frequent shaking. Cool, fill the flask to the mark, shake thoroughly, and filter off 100 cc. of the solution into a beaker. Acidulate this solution slightly, heat to boiling, add a slight excess of ammonia, and boil again. Filter off the phosphate of alumina, wash thoroughly, dry, ignite, and weigh. Multiply the weight of substance obtained by the factor 41.8.

For the determination of iron, place 100 cc. of the hydrochloric acid solution in a 250 cc. flask, add some pure zinc, a little dilute sulphuric acid, and allow to stand about 1 hour in a warm place in order to reduce the iron oxid. Cool, fill the flask to the mark, and filter off 50 cc. of the solution into a beaker containing 50 cc. of 20 per cent sulphuric acid and 200 cc. of water, and titrate with permanganate solution. A second, third, and even fourth titration may be made in the same solution.

Determinations are reported which show that the method gave results closely agreeing with the theoretical percentages in a phosphate

of alumina of known composition. The sum of alumina and iron shown by this method was somewhat lower than that given by direct determination in the Glaser method. This is explained by the fact that in the Glaser method no account is taken of the difference in molecular weight of the iron and aluminum oxids in calculating the results of analysis.

Solubility of phosphates in citric acid and ammonium citrate, O. FOERSTER (*Chem. Ztg., 20 (1896), No. 103, pp. 1020, 1021*).—It has been generally observed that calcium phosphates as well as aluminum and iron phosphates are more soluble in ammonia-free citric acid than in ammonium citrate. This has also been observed in the case of slags, and is ascribed especially to the presence of iron and alumina phosphates. These general conclusions were confirmed by the author in examinations of tricalcium and tetracalcium phosphate, iron phosphate, alumina phosphate, and 8 samples of Thomas slag, the results of which are reported. In only two cases did the slag show a greater solubility in ammonium citrate than in pure citric acid. It is suggested that the unusual results in these two cases may be explained by variations in the conditions of solution and in composition of the dissolved matter. It is proposed to make this the subject of further investigation.

Natural and industrial phosphates: III. The insoluble residue, H. LASNE (*Ann. Chim. Analyt., 1, p. 207; abs. in Analyst, 21 (1896), Sept., p. 246*).—The residue from the hydrochloric acid solution is calcined and silica driven off with hydrofluoric acid, the residue being recalcined and weighed. The new residue is dissolved in sulphuric acid and tested for alumina, alkalies, phosphoric acid, titanic acid, and zirconium, the presence of the latter indicating the origin of the phosphate. Barium should also be looked for, its presence indicating adulteration with plaster of Paris.

The determination of phosphoric acid in potable water, C. LEPIERRE (*Bul. Soc. Chim. Paris, 15–16 (1896), No. 23, pp. 1213–1217, figs. 2*).—It is maintained that the method in which the phosphoric acid is determined by weighing the phosphomolybdate is unreliable on account of the solubility of this compound.

A method based on the color of a nitric acid solution of the phosphomolybdate is proposed as follows: Evaporate 1 liter of the water to dryness in a platinum dish, with the addition of nitric acid, and heat to separate silica. Take up in dilute nitric acid and evaporate to dryness again to eliminate the last traces of silica. Moisten with nitric acid and filter the solution, washing the filter until the filtrate amounts to 50 cc. Add 2 cc. of molybdic solution and compare the coloration, in the cold, with that of standard solutions of phosphomolybdate, prepared by adding molybdic solution to water solutions of phosphate containing from 0.1 to 25 mg. of phosphoric acid. For exact work the temperature should be in all cases about 30° C.

The determination of albumen in cows' milk, L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 522–526*).—In the Annual Report of

the Station for 1893 (E. S. R., 6, p. 966) a description is given of the determination of casein in milk. In the method here described for determining albumen the filtrate from the determination of casein with acetic acid is digested in a boiling water bath until the albumen coagulates and settles to the bottom, leaving the supernatant liquid clear. Ten or 15 minutes is said to usually suffice for this. The nitrogen is determined in the washed precipitate by the Kjeldahl method, and the amount of nitrogen multiplied by the factor 6.25 gives the albumen.

To determine the effect of continued digestion, trials were made in which the solution was digested for from 5 minutes to 10 hours. The conclusions from these trials were as follows:

"(1) In one case heating for 5 minutes gave low results; in two other cases, good results.

"(2) In general, the results varied little with increased length of time of heating.

"(3) There was a slight tendency to higher results with increased length of heating, but such increase was more or less irregular and at most amounted to only 0.002 or 0.003 per cent of nitrogen.

"(4) It would, therefore, appear that entirely satisfactory results can be obtained by heating the solution containing albumen under the given conditions for 10 or 15 minutes, while an increased length of time of heating does not practically change the results.

"It may be stated that the precipitate formed always filters readily and washes easily."

A brief summary is given of the method employed by the author for the separation and determination of the different nitrogenous compounds of cows' milk based on the method as described.

Potassium chromate as a milk preservative, J. FROIDEVAUX (*Jour. Pharm. et Chim., ser. 6, 16 (1896), pp. 155–158; abs. in Analyst, 21 (1896), Nov., p. 285*).—The author finds that at least 0.2 gm. of neutral potassium chromate per liter is necessary for preserving milk appreciably, and this amount gives the milk an abnormal color. For the detection of chromates in milk the method of Denigès (addition of 1 cc. of 2 per cent silver nitrate to 1 cc. of milk) is satisfactory where over 0.01 gm. per liter is present. The following method is preferred: Dissolve the ash from 10 cc. of milk in a few drops of water acidified with nitric acid, neutralize with magnesium carbonate, and add silver nitrate (preferably a 20 per cent solution). Another test given is as follows: Dissolve the ash from 10 cc. of milk or water acidulated with sulphuric acid, and add tincture of guaiacum little by little. An intense blue color which rapidly disappears is produced when chromates are present. The reaction is said to detect 0.02 to 0.03 gm. of chromate per liter.

Report of the chemist of South Carolina Station, M. B. HARDIN (*South Carolina Sta. Rpt. 1895, pp. 51–63*).—Analyses are given of cotton-seed meal, "brewery feed," "corn chops," sugar beets, sweet potatoes and millet seed for starch, acid phosphate floats, Pamunkey phosphate, Florida phosphate, muriate of potash, sulphate of potash, kainit, mixed fertilizers, water, phosphate rock, wood ashes, ores, and minerals.

Four samples of sweet potatoes contained in the dry substance 52.3, 56.28, 63.69, and 67.12 per cent of starch. Two samples of millet seed contained in the dry substance 53.76 and 70.75 per cent of starch. With respect to the analyses of commercial fertilizers, the analyses of which are not given, the statement is made that—

"Twenty-three of the 206 samples, or 11.16 per cent, are below guaranty.

"These results show an improvement in the commercial fertilizers on our market; for while the manufacturers have in some cases made lower guaranties this year the average percentages of fertilizing ingredients actually found this year are for the most part higher than those of last year. The only marked exception is in the case of cotton-seed meal, in which the average of ammonia is somewhat lower.

"It should be added that all fertilizers of last year which fell below guaranty in any ingredient were classed as 'deficient,' while for this year only three are 'deficient' under the present law, which requires only that the commercial value based upon results of analysis shall not fall 3 per cent below the commercial value based upon guaranty."

The action of phosphorus on platinum, A. GRANGER (*Compt. Rend., 123 (1896), No. 26, pp. 1284, 1285*).

The estimation of potash by the Carnot method, E. GOUTAL (*Ann. Chim. Analyt., 1, pp. 89–91; abs. in Analyst, 21 (1896), Aug., p. 216*).

A new reagent for asparagin, L. MOULIN (*Jour. Pharm. et Chim., ser. 6, 16 (1896), p. 543; abs. in Analyst, 21 (1896), Dec., p. 332*).

The estimation of starch in sausage, F. MAYRHOFER (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), No. 13, pp. 429, 430*).

A color reaction for peanut oil, A. VAN ENGELEN (*Bul. Assn. Belge, 10 (1896), pp. 161, 162; abs. in Analyst, 21 (1896), Oct., p. 258*).

Examination of the oil of linseed cake, B. A. VAN KETEL and A. C. ANTUSCH (*Ztschr. angew. Chem., 1896, pp. 581–583; abs. in Analyst, 21 (1896), Nov., p. 299*).

Measurement of rancidity of fats other than butter, A. SCALA (*Staz. Sper. Agr. Ital., 28, p. 733; abs. in Analyst, 21 (1896), Nov., p. 298*).

The detection of borax in butter, PLANCHON and VUAFLART (*Jour. Pharm. et Chim., 1896, pp. 49–51; abs. in Analyst, 21 (1896), Nov., p. 286*).

Detection and estimation of sodium bicarbonate in milk, L. PADE (*Ann. Chim. Analyt., 1, p. 328; abs. in Analyst, 21 (1896), Nov., p. 286*).

Detection of formic aldehyde in milk, C. DENIGÈS (*Bul. Soc. Pharm. Bordeaux, 1896, July, p. 212; abs. in Ann. Chim. Analyt., 1, p. 316; and Analyst, 21 (1896), Nov., p. 285*).

Value of various chemicals for preserving milk which is to be kept a long time for investigation, J. KLEIN (*Milch Ztg., 26 (1896), No. 47, pp. 745–748*).—As a result of trials of a large number of preservatives the author recommends ammoniacal copper sulphate. From 0.5 to 1 per cent is added to the milk, which is well shaken. Where possible the milk should be tested within a month. For keeping milk a short time the copper salt of formalin is recommended.

Detection of foreign coloring matters in red wines, A. BELAR (*Ztschr. analyt. Chem., 35 (1896), p. 323; abs. in Analyst, 21 (1896), Nov., p. 289*).

The determination of free lactic and succinic acids in wines, J. A. MULLER (*Bul. Soc. Chim. Paris, 15–16 (1896), No. 23, pp. 1203–1206*).

Lactic acid in Algerian wines, J. A. MULLER (*Bul. Soc. Chim. Paris, 15–16 (1896), No. 23, pp. 1210–1213*).

The detection of nitric acid in wine, E. SILZ (*Rev. Chim. anal. appliq., 4 (1896), p. 477; abs. in Chem. Ztg., 20 (1896), No. 104, Repert., p. 314*).

Estimation of phosphoric acid in medicated wines, F. GLASER and K. MÜHLE (*Chem. Ztg., 20 (1896), No. 75, p. 723; abs. in Analyst, 21 (1896), Nov., p. 292*).

Optical analysis of urine and the exact determination of proteids, glucosids,

and unfermentable saccharine substances, F. LANDOLPH (*Compt. Rend., 123 (1896), No. 26, pp. 1301, 1302*).

Analyses of ores and minerals, M. B. HARDIN (*South Carolina Sta. Rpt. 1895, p. 62*).—Examinations of 39 samples of gold, iron, and other ores are briefly reported.

Report of chemical division, H. J. WHEELER (*Rhode Island Sta. Rpt. 1895, pp. 287–293*).—This includes statements regarding the fertilizer inspection in the State, tests of methods of determining potash, field and pot experiments, correspondence, etc.; and tabulated analyses of 25 samples of fertilizing materials, including fine-ground kieserite, Epsom salts, dissolved phosphate rock, slag meal, floats, dissolved bone black, tankage, leather, dried blood, sulphate of ammonia, nitrate of soda, double superphosphate, fine-ground bone, wood ashes, limekiln ashes, muriate of potash, carbonate of potash, air-slacked lime, land plaster, muck, and clay.

BOTANY.

Fertile crosses of teosinte and maize, J. W. HARSHBERGER (*Garden and Forest, 9 (1896), No. 462, pp. 522, 523*).—An account is given of the probable origin of *Zea canina* described by Watson.[1] This plant, which is known in Mexico as *Maiz de Coyote*, *Teosinthe*, *Asesé*, or *Café de Tabasco*, is said to be the result of crossing *Euchlæna mexicana* and the common maize. The author quotes correspondence from prominent Mexican scientists who have investigated the subject, in which it is stated that the *Zea canina* may be produced by planting teosinte and maize at distances of about 80 cm. and removing the staminate flowers from the teosinte, allowing the pistillate ones to be fertilized by the pollen of the maize. A detailed account of the effect of this process is given as follows:

"When teosinte is crossed with maize by the use of maize pollen the hybrid progeny of the first generation shows a shortened branch in the axil of a leaf with 3 or 4 ears clustered together and surrounded by leaves which are commonly called husks. These ears resemble very much those of teosinte, in that they are 2-ranked, with the kernels in the hardened depression of an enlarged zigzag rhachis, which shows the beginning of a cob-like axis, on which, in this case, the grains are disposed in a distichous manner. The kernels are larger, sharp-pointed, and protrude between the chaffy scales (glumes) from the cup-shaped depression of the axis, which is, in this case, shallower than in teosinte. The outer glume, which is hard in teosinte, becomes larger and softer in the hybrid progeny. The axis is still firm, glossy, and chitinous. The second year maize pollen is again used to cross with the hybrid plants of the first generation. The result of this cross is a form of ear in which the kernels are larger, fuller, and more rounded, while the corneous basin-shaped depression has become smaller and more shallow. The kernels in this generation are usually arranged in a distichous manner. The third year pollen of Indian corn is again used, and the resulting ears are found to differ in the increase of the number of rows of grains, 4 or more being present; the pithy axis, or cob, now becomes demarcated, and is seen when the ear is broken transversely. The plants of this year and of the fourth are evidently those described by Professor Watson under the name of *Zea canina*."

This hybrid was considered by the author, in his botanical and economic study of maize published in 1894, as probably the primitive form of our cultivated maize.

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[1] Proc. Amer. Acad. Arts and Sciences, 26, p. 158.

Viewed in the light of these cross-breeds or hybrids it may be considered (1) that maize is generically and specifically a distinct plant; (2) that it owes its origin to a crossing of teosinte, as one of the parents, with pollen of an extirpated closely related grass, and that the progeny of this cross by variation under cultivation produces ears of considerable size with kernels of great nutritive value, or (3) that it is a result of a cross between teosinte and a race or variety of that plant produced by successful cultivation of the wild plant until its characteristics as a variety or race have become fixed.

The author thinks that if we consider Indian corn to have arisen as a cross-breed or hybrid, the appearance of many of the teratological forms frequently found in cultivation will be explained. In conclusion, it is thought that the wild ancestor of maize is teosinte; but if this view is not accepted, the fact that the two plants may be crossed and produce fertile progeny shows that they are united by very close relationship.

In a supplemental note[1] the author states that W. Trelease reports corn smut, which is commonly believed to confine its attacks to maize, as growing parasitically on teosinte.

Influence of nitrogen on root formation, H. MÜLLER-THURGAU (*Jahresber. Vers. Sta. Wädensweil, 4, pp. 48–52; abs. in Bot. Centbl., 68 (1896), No. 9, p. 298*).—The author reports upon a series of experiments on the effect of nitrogen on the secondary roots of common vetch, red clover, grapes, maize, sunflower, gourds, beans, alfalfa, and *Lathyrus superbus*. The plantlets were grown for a short time in distilled water, after which 2 of each kind were placed in vessels. One was fed with a normal nutrient solution, while the other was given the same solution except that there was no nitrogen present.

In every experiment the effect of the nitrogen was the same. In the solutions containing nitrogen the secondary roots made a more vigorous growth and were much more abundant. There also appears to be a direct and an indirect influence of the nitrogen supply. All the growing parts while richer in nitrogen are able to form more protein and the root system being more developed conveys more material to the other parts of the plants. The author believes his experiments show the ability of roots to form albuminoids.

The rôle of bacteria in the nutrition of insectivorous plants, N. TISCHUKIN (*Acta. Hort. Petropol., 12; abs. in Rev. Mycol., 19 (1897), No. 73, pp. 18, 19*).—The author believes that bacteria play a very important part in the digestion of albuminoid substances in these plants.

His conclusions are as follows: Albumin is not dissolved by the plant juices in the especially differentiated receptacles, but by the microörganisms, principally bacteria, abounding in the liquids. These organisms are always found present in the normally developed plant juices of the insectivorous plants. The dissolution of albumin begins only when the microörganisms are sufficiently developed and abundant.

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[1] Garden and Forest, 10 (1897), No. 467, p. 48.

The name "insectivorous" should be applied to plants capable of absorbing the material prepared for them by the lower organisms, the rôle of the plant being that of a secretor of juices adapted to the nutrition of microörganisms.

The survival of the unlike, L. H. BAILEY (*New York: The Macmillan Company, 1896, pp. 515, figs. 21*).—This volume consists of a collection of 30 essays on evolution, suggested by the study of domesticated plants. All of them have hitherto appeared as addresses before horticultural and other scientific bodies, or as special articles contributed to various publications. Although prepared and delivered at various times extending over a period of nearly 4 years, their ultimate collection was constantly in mind, so that there should be a sort of continuity to the whole. As the author states, there are necessarily repetitions, but such do not detract from the work as a whole. The motive underlying the collection of essays is that of unlikeness. According to the author, heredity is an acquired force, and normally unlike produces unlike. He maintains that unlikeness in plants is "(1) the expression of ever-changing environmental conditions in which plants grow, and of the incidental stimuli to which they are exposed; (2) the result of the force of mere growth; and (3) the outcome of sexual mixing." Plants survive because they are unlike their neighbors, and in this way encounter less resistance in the field of competition.

The essays are grouped into 3 categories: (1) Those touching the general fact and philosophy of evolution, (2) those expounding the fact and causes of variation, and (3) those tracing the evolution of particular types of plants. The author is strongly opposed to Weismannism, and in the discussion of the theories of evolution, as well as in the essay on bud variations, seems to advance arguments strongly substantiating his position.

Numerous examples are cited of plants which from their characteristics would fulfill the conditions of the most exacting systematic botanists as to species were their origin unknown, yet all such species are rejected by the taxonomist on account of their being the result of direct and in some cases designed experimentation. The author believes that the garden fence plays too important a part in species making, and that many botanists are disposed to look upon species as fixed entities rather than plastic groups designed for more or less temporary convenience. The assistance given nature by man in evolving new species is said to differ only in degree and not in kind from the processes that are everywhere going on. The extended observations and experimentation of the author show that tomatoes, beans, and other garden plants can be made to vary in certain desirable lines, producing progeny unlike themselves.

In his contributions to the philosophy of evolution, and the record of the evolution of certain types of plants and the causes underlying their production, the author has furnished much information to all students of evolution as well as of horticulture and botany.

Systematic arrangement of the beeches, F. KRASSER (*Ann. k. k. natur. Hist. Hofmuseums, Wien, 11 (1896), No. 2, pp. 149–163*).—According to the author there are 2 genera, Fagus represented by 4 species and Nothofagus by 17 species.

The systematic arrangement of the Protophyta, C. E. BESSEY (*Amer. Nat., 31 (1897), No. 36, pp. 63–65*).—A provisional arrangement of the families and genera of protophytes is given by the author. The slime molds are excluded from the classification, the author considering them zoölogical and not botanical.

Concerning the parallelism between the Tuberaceæ and Gastromycetes, E. FISCHER (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 300–311*).

Parallel forms of Uromyces scutillatus in different countries, P. MAGNUS (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 374–377*).

Concerning Cladothrix dichotoma and C. odorifera, W. RULLMANN (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 22, pp. 701–706*).

Concerning Cinctractia seymouriana, P. MAGNUS (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 391, 392*).—This parasite was first described as *Ustilago crus-galli* n. sp. by Tracy and Earle (*Torrey Bul., 22 (1895), p. 175*), hence the name becomes, with the change necessary in transposing it, *Cinctractia crus-galli*.

The common Ustilago of maize, J. C. ARTHUR (*Bot. Gaz., 23 (1897), No. 1, pp. 44–46*).—The author has investigated the synonomy of the common corn smut and states that the name should be written *Ustilago zeæ*.

Some observations on Uredineæ, H. T. SOPPITT (*Gard. Chron., ser. 3, 21 (1897), No. 526, pp. 67, 68*).—Notes are given of *Puccinia bistorta*, the æcidial host of which is *Conopodium denudatum*.

Contributions to the anatomy and physiology of the lower organisms, E. CRATO (*Beiträge Biol. Pflanz., 7 (1896), No. 3, p. 407; abs. in Naturw. Rundschau, 12 (1897), No. 1, pp. 7–9*).

Some recent biological investigations, F. HILDEBRAND (*Ber. deut. bot. Ges., 14 (1896), No. 9, p. 325*).—Notes are given of the sterility of certain crucifers to their own pollen and changes observed in various plant stocks, as dahlia, petunia, and cyclamen.

Effect of bacteria on germination, A. LAGERVALL (*Red. verks. Ultuna landtbruk-inst., 1895, pp. 49–52; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 22, pp. 714, 715*).—Experiments are reported on the effect of bacteria on the germination of rye, wheat, and peas. Sound seed and some that had their seed coats punctured were inoculated and then germinated. In each case the check lots gave the highest percentage of germination. Where the seed coats were injured the germination of the inoculated seed was lowered considerably below that of the check.

Investigations on the formation and regeneration of periderm, epidermis, cork, and cuticle, H. TITHMANN (*Pringsheim's Jahrb. wiss. Bot., 30 (1896), No. 1, pp. 116–154*).

Contributions to the knowledge of artichokes, G. MEYER (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 347–362, pl. 1*).—Studies are given of the morphology, anatomy, and physiology of artichokes, *Helianthus tuberosus*.

On the structure of the fundamental protoplasm of a species of Mortierella, L. MATRUCHOT (*Compt. Rend., 123 (1896), No. 26, pp. 1321–1323*).

On the correlation of growth as a consequence of the mechanical checking of growing, F. HERING (*Pringsheim's Jahrb. wiss. Bot., 29 (1896), pp. 132–170, figs. 4; abs. in Bot. Centbl., 58 (1896), No. 12, pp. 405–408*).

Pollen bearing vs. plant vigor, M. G. KAINS (*Garden and Forest, 10 (1897), No. 466, p. 38*).—Notes are given of some experiments in emasculating flowers that seem to indicate an increased vigor in the plants thus treated.

Notes on the fertilization and embryogeny of conifers, J. M. COULTER (*Bot. Gaz., 23 (1897), No. 1, pp. 40–43, pl. 1, fig. 1*).

The changes in fat during germination and their significance, M. WALLERSTEIN (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), p. 372; abs. in Chem. Ztg., 20 (1896), No. 104, Repert., p. 314*).

The absorptive power of soluble starch, M. W. BEYERINCK (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 22, pp. 697–699*).

A contribution to the chemistry of the red coloring matter of plants (*Ztschr. Nahr. Untersuch. und Hyg. Waarenk., 10 (1896), No. 24, pp. 393, 394*).—A résumé of conclusions of a paper by L. Weigert is given.

The amount of copper taken up by vegetables from a coppery soil, K. B. LEHMANN (*Arch. Hyg., 27 (1896), No. 1, p. 1; abs. in Analyst, 21 (1896), Nov., p. 290*).

On protein formation in plants, B. HANSTEIN (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 362–371*).—A preliminary paper in which literature is reviewed.

Concerning the influence of strain and pressure upon the direction of partition walls in plant cells, L. KNY (*Ber. deut. bot. Ges., 14 (1896), No. 9, pp. 378–391, figs. 2*).

Investigations of the assimilatory organs of the Leguminosæ, J. REINKE (*Pringsheim's Jahrb. wiss. Bot., 30 (1896), No. 1, pp. 1–70, figs. 47*).—The studies are of the leaves and young branches.

Studies of some leaf galls, H. FOCKEN (*Rev. gén. Bot., 8 (1896), No. 96, pp. 491–506, pls. 12*).

Plant galls formed by insects, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 695–699, pl. 1, fig. 1*).

Variation in ferns and its relation to Weismann's theory of heredity, STANFIELD (*Gard. Chron., ser. 3, 21 (1897), No. 524, pp. 30–32*).

Some new fungi from Alabama, F. S. EARLE (*Torrey Bul., 24 (1897), No. 1, pp. 28–32*).—Descriptions and notes are given of 12 new species of *fungi imperfecti*.

New or noteworthy American grasses, G. V. NASH (*Torrey Bul., 24 (1897), No. 1, pp. 37–44*).—The following new species are described: *Erianthus tracyi, Paspalum simpsoni, P. villosissimum, Panicum albo-marginatum, P. leucothrix, P. manatense, Agrostis idahoensis*, and *Danthonia glabra*.

Need of instruction in experimental plant physiology, F. W. CARD (*Garden and Forest, 10 (1897), No. 464, p. 18*).

METEOROLOGY.

The climate of Geneva, New York, P. COLLIER (*New York State Sta. Rpt. 1894, pp. 138–146, 770–779*).—Meteorological observations at the station during 12 years on air and soil temperatures, precipitation, and sunshine are summarized in tables and notes.

The station is located 175 ft. above Seneca Lake, the latter being 567 ft. above the sea level. The average annual rainfall at the station during 12 years has been 27.73 in., the maximum 36.88, and the minimum 22.29. It has generally been uniform and very uniformly distributed. In the same period the average monthly rainfall during the 7 months, April to October, inclusive, has been 2.86 in., and there have been but 2 years when the rainfall has been less than 1 in. in April, May, and September, and but 1 year when it has been less than 1 in. in October. The average monthly precipitation during the period from November to March, inclusive, has been 1.47 in., the maximum 1.77, and the minimum 1.21 in.

During 10 years of the period the average sunshine for the 7 months from April to October was 45.7 per cent of the possible amount, the maximum 54.5, and the minimum 38.8 per cent. During the 5 months from November to March the average has been 27 per cent, the maximum 33.7, and the minimum 19.1 per cent.

The average temperature of the months from April to October, inclusive, as recorded by standard air thermometers during 10 years, was 60.7° F., while for the months from November to March, inclusive, it was 28.9° F.

Detailed daily and monthly summaries of observations during 1894 on sunshine, wind movement, and temperature are added.

Meteorological report, 1895, N. HELME (*Rhode Island Sta. Rpt. 1895, pp. 359–365*).—This includes a summary of observations on temperature, precipitation, and cloudiness for 6 years (1890–'95) and a tabulated record of temperature, pressure, precipitation, cloudiness, and

direction of wind for each month of 1894 and 1895. The summary for 1895 is as follows:

Temperature (degrees F.).—Mean, 48.2; maximum, 95, June 2; minimum, —7, February 6; annual range, 102; highest monthly mean, 69.4, August; lowest monthly mean, 21.7, February; highest daily mean, 79, June 2; lowest daily mean, 1, February 8. *Precipitation* (inches).—Total (rain and melted snow), 49.28; greatest monthly, 7.89, October; least monthly, 1.29, September; *snowfall*—total, 40½g; reatest monthly, 16, January; least monthly, 5, March. *Weather*.—Number of clear days, 128; number of fair days, 114; number of cloudy days, 123; number of days on which 0.01 in. or more of rain fell, 108. *Air pressure* (inches).—Maximum, 30.56, December; minimum, 28.49, February; mean, 29.83.

WATER—SOILS.

Alkali, B. C. BUFFUM (*Wyoming Sta. Bul. 29, pp. 219–253, pls. 6*).—This bulletin contains a brief discussion of the character and occurrence of alkali in Wyoming and of its effect upon soils and plants; reports experiments on the influence of different amounts of alkali on the germination and growth of turnips, barley, rye, oats, wheat, and alfalfa, and gives suggestions regarding the reclamation of alkali soils. The germination tests were conducted in plates in a greenhouse, the seeds (100 in each case) being placed (1) in soil from which the alkali had been leached, (2) between blotters and filter papers, (3) in alkali soil which had been leached until it contained only 1 per cent of alkali, (4) in natural alkali soil containing 2.24 per cent of soluble salts, (5) in extracted soil (like 1) to which 2.25 per cent of soluble salts mixed in the same proportions as the natural alkali was added, and (6) extracted soil containing 5 per cent of this mixture.

Experiments were made with the same crops and soil mixtures in 5-inch pots (containing 1 kg. of soil mixture).

The results are summarized as follows:

"The white alkali of general occurrence in Wyoming consists principally of sulphates of sodium and magnesium.

"One per cent or more of these salts in the first 2 in. of surface soil will make it unproductive for any but plants which naturally inhabit saline soils.

"Small amounts of alkali in the soil retard germination and growth in proportion to the amount present. This effect is physiological.

"Alkali soil may be reclaimed by leaching out the salts, where there is drainage naturally or artificially supplied.

"The rapid rise of alkali may be checked or prevented by hindering surface evaporation through cropping and proper cultivation.

"Plants that thrive comparatively well on alkali soil are sugar beets, white sweet clover (*Melilotus alba*), 'salt sages' (*Atriplex* spp.), and alfalfa under certain conditions. Rye does better than other cereals.

"To determine whether the soil is colder when it contains large amounts of alkali a careful series of the soil temperatures in the pots was taken, but no difference in the warmth could be detected between the soil free from alkali and that containing 5 per cent of the salts. However, in this connection it should be stated that in the experiment the moisture was controlled so that each soil contained the same amount. In the field a soil containing alkali will retain more moisture than one free from salts, which might make the alkali soil have a lower mean temperature for the growing season."

Investigations on the water capacity of the soil, R. ULRICH (*Forsch. Geb. agr. Phys., 19 (1896), No. 1–2, pp. 37–56*).—Mineral soils—kaolin, clay, calcareous sand, and quartz sand; humus soils—humus calcareous sand, hotbed soil, and Russian black soil; and different kinds of humus—sugar humus and peat, were placed either in glass beakers, with ground ends and covers, 5.5 cm. in diameter and 8.8 cm. high, or in zinc cylinders (also with covers) 12 cm. in diameter and 7 cm. high, and saturated with water. The beakers and cylinders were kept at the desired temperature in a closed zinc box on a water bath, or surrounded by a water coil, for 24 hours, and weighed. The bottoms of the cylinders were then allowed to dip into water while they were kept at the desired temperature for another 24 hours. They were weighed after the excess of water had dripped away, and this treatment was repeated for successive 24-hour periods until the weight was constant. With the mineral soils the higher the temperature the smaller the amount of water retained. The reverse was true with the humus and humus soils.

In a similar manner the influence of sodium and potassium hydrates and sodium, potassium, and ammonium carbonates; monosodium, monopotassium, monocalcium, monomagnesium, and diammonium phosphates; sodium, potassium, ammonium, magnesium, and iron sulphates; sodium, potassium, ammonium, calcium, and magnesium nitrates and chlorids; and calcium hydrate and sulphate in amounts of 0.025, 0.05, 0.075, and 0.1 gm. upon the water capacity of kaolin was determined.

The results show that (1) the hydrates, carbonates, and phosphates lowered the water capacity; (2) the sulphates exerted practically no influence; and (3) the nitrates and chlorids and calcium hydrate increased the water capacity. The influence of the first and last classes of compounds increased with the amounts present.

A contribution to the study of nitrification, MARCILLE (*Ann. Agron., 22 (1896), No. 7, pp. 337–344*).—In comparative tests it was found that while the nitrogen of ammonium phosphate was not so readily transformed into nitrous acid as that of ammonium sulphate, the phosphate appeared to furnish a much more favorable medium for the transformation of nitrites into nitrates than the sulphate.

It was also found in comparative tests that nitrification was much more rapid in a soil from Guadeloupe than in one from Eure-et-Loir. Since no increase in nitrification was noted when the latter soil was inoculated with organisms from the former the author concludes that the difference was not due to the greater energy of the organisms of the Guadeloupe soil but to differences in physical and chemical properties of the soils, especially to the nature of the organic matter present.

Nitrification, E. GODLEWSKI (*Anzeig. Akad. Wissensch. Krakau, 1895, pp. 178–192; abs. in Ann. Agron., 22 (1896), pp. 303, 304; Jour. Chem. Soc., 1896, Dec., II, p. 668*).—Previous experiments by the author had indicated, contrary to the observations of Winogradsky, that the

nitrifying organisms derive their carbon from carbon dioxid and not from carbonates. To further test this matter 3 experiments were instituted in which solutions containing like amounts of ammonium sulphate and magnesium carbonate were inoculated with nitrifying organisms. In 2 of the experiments the apparatus was filled with air containing carbon dioxid; in the other with pure air. In the first case there was a reduction of volume which was not noticed in the latter case. The magnesium carbonate was not utilized as a source of carbon. In the presence of carbon dioxid the nitrifying organisms converted almost all of the ammonia into nitrous acid, although no nitrates were formed and a variable amount of the nitrogen was lost in the free state.

Forestry-meteorological observations, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 1–2, pp. 151–171*).—These include studies of the influence of plant cover on the carbon dioxid content of soil air, on the organic and mineral constituents of the soil, and on the productive capacity of the soil. Data for observations on the carbon dioxid content of the soil air, and on the carbon, humus, and nitrogen in the cases of soils covered with pines (with and without cover of litter), with birches, and with grass, and manured and unmanured plowed land are tabulated. The yields on bare soils and on soils which had been covered in previous years with several different kinds of plants are also given.

The results show that soils covered with plants contained more carbon dioxid than bare soils, the conditions being otherwise the same. This was not true of soil to which manure had been applied. In this case the carbon dioxid content was much greater than in any other case. There was a larger percentage of carbon dioxid in the air of the soil covered with grass and with birches than in that bearing pines. In the case of the pines the amount was greater where the soil was covered with litter than where the litter had been removed.

Soils covered with living plants contained considerably more carbon, humus, and nitrogen than the bare soil, other conditions being the same. Of the soils covered with vegetation, those in grass and pines with a cover of litter contained more of these constituents than similar soils in birches and pines without litter. In the soils covered with plants the increase of carbon was relatively higher than that of nitrogen. In 7½ years there was a marked increase of these constituents in soils covered with plants, and a decided loss of organic matter in bare soils of similar character.

Soils covered with vegetation contained a larger amount of mineral matter soluble in hydrochloric acid than those remaining bare, the conditions being otherwise the same. This difference was most marked in the case of lime, the other constituents being affected to a much less extent. The soils in grass and in pines with a cover of litter contained a larger amount of mineral matter, especially of lime, than those in pines without a cover of litter and in birches.

The yield on soils which had previously been for a number of years in forest was considerably greater than on those which had remained

bare. Those soils which had been in pines with a cover of litter were more productive than those which had been in pines without a cover of litter or in birches.

The recognition of the acidity of upland soils and its bearing upon agricultural practice, H. J. WHEELER, B. L. HARTWELL, and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 232–280, pls. 3*).—Previous experiments (E. S. R., 7, p. 377) had shown that on certain upland, well-drained soils ammonium sulphate exerted a poisonous effect. This result appeared to be due to acidity of the soil. The literature of this subject is exhaustively reviewed and the results of all experiments bearing upon the subject conducted under the supervision of the station are discussed, the conclusions being summarized as follows:

"The removal of plants from the soil and the use of certain fertilizers doubtless exhaust the lime and other basic ingredients of the soil more rapidly than would be the case were nature allowed to take her course.

"That an acid condition is liable to result in consequence of the above-mentioned operations, particularly in the case of soils derived from rocks deficient in basic ingredients, we believe to be a reasonable assumption.

"While some plants like clover, timothy, and beets appear to be injured by a lack of carbonate of lime or by the resulting acidity of the soil, others appear to thrive best under such conditions.

"A strongly marked reddening of blue litmus paper seems to be a simple and effective indication of the condition of a soil in the above-mentioned particulars.

"The value of a satisfactory method for determining the relative acidity of soils would seem to be great.

"A dangerous degree of acidity or at least a fatal lack of carbonate of lime appears to exist in upland and naturally well-drained soils, and is not confined to muck and peat swamps and very wet lands as most American and many other writers seem to assume, in view of which it appears that the test for acidity should be more generally applied to such soils.

"That this condition of upland soils has not been more fully recognized heretofore is not surprising for the reason that the failure or partial failure of certain crops has been attributed to winterkilling, poor germination of seeds, drought, excessive moisture, or attacks by insects or fungi. Upon soils where certain plants are injured only to a limited extent by acidity others would be expected to thrive best of all, in consequence of which it is not surprising that the cause for the partial failure of certain crops upon them has not been suspected.

"The inefficiency of land plaster as compared with air-slacked lime in the culture of beets and in overcoming the ill effect of sulphate of ammonia, as well as the highly beneficial results from the use of caustic magnesia and carbonate of soda, all tend to further strengthen the position that the fault of the soil in question is a lack of basic ingredients, to which the presence of noxious compounds which may partly or wholly give rise to the acid reaction, is attributable."

Further observations for the purpose of determining in how far the results secured in a soil test with a given plant are applicable to others, H. J. WHEELER and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 200–204*).—In a soil test made in 1894 with 37 kinds of plants and described in the Annual Report of the Station for 1894 (E. S. R., 7, p. 851), it was found that all but 3 kinds (white bean, sunflower, and summer squash) indicated the soil to be more deficient in phosphoric acid than in nitrogen or potash. The test was continued

in 1895 with 10 kinds of plants, increasing the number of rows of the 3 kinds which the previous year had indicated a greater deficiency of potash than of phosphoric acid.

"The results with beans in 1895 have not been conclusive, but those with the sunflower and the summer squash show a greater deficiency of phosphoric acid than of nitrogen or potash, and contradict, therefore, the indications afforded by the test with 2 rows only in 1894. When it is considered, however, that 16 rows each of sunflowers and of summer squashes were employed in 1895, and but 2 rows of each in 1894, it will be seen that strong evidence is afforded that the 1894 results were merely incidental, and that of the 37 plants which have been tested in the 2 years probably not one would fail, under satisfactory conditions, to show a deficiency of phosphoric acid in the soil. For the purpose of arriving at fully definite conclusions in regard to this point it is hoped to continue the experiment, particularly with beans, and perhaps with sunflowers and summer squashes, for at least another season."

North Dakota soils, E. F. LADD (*North Dakota Sta. Bul. 24, pp. 57–73*).—Mechanical and chemical analyses of 10 samples of soil from the Red River Valley, 4 from the James River Valley, 2 from the Sheyenne River Valley, 2 from Mouse River Valley, 6 from the Devils Lake region, 5 from the northern counties and Turtle Mountain region, 1 each from Welles County and Sisseton Reservation, and 2 from west of the Missouri are tabulated and discussed.

"The soil of North Dakota is a drift or alluvial loam ranging from 6 in. to 3 ft. deep, and in color from black to grayish-brown. The soils for different parts of the State differ considerably both in physical and chemical properties, but successful agriculture is more influenced by meteorological or climatic conditions than by any difference in the chemical properties of the soil. The western half of our State lies within the great semihumid belt lying east of the Rocky Mountains, and extending from north to south across the United States, and underlaid by the great artesian basin, where irrigation may be possible. . . .

"Some of the samples of soil have been taken from the unbroken virgin prairie, and others from fields for 15 years or more under cultivation, mainly in wheat. . . .

"The soils having the finest mechanical condition are outside of the Red River Valley, and in the so-called semihumid belt. These soils are exceedingly retentive of moisture, as is shown by their capacity to hold water, and by experiments. For this reason the small annual rainfall suffices to produce a good yield of grain crops. Probably the better increase of wheat observed after bare summer fallow, when the soil is frequently cultivated, is not due so much to resting the land or making available plant food as to conserving the moisture in the soil, storing it up so that a larger supply is available for the growing crop of the succeeding year."

Examinations of the humus in 32 of the soil samples, showing percentages of humus and ash and phosphoric acid in humus, are reported, and the character and importance and loss of this substance from soils under cultivation (especially bare fallowing) are discussed.

"On the College farm the unbroken prairie showed 109 tons of humus per acre, while similar land under cultivation on the same farm showed but 63 tons per acre.

"In 1891 a field showed 5.35 per cent of humus, and 0.79 per cent of phosphoric acid was in the humus. Crop rotation was adopted, and in 1894 the field showed 6.82 per cent of humus and 0.091 per cent of phosphoric acid in the humus, showing that it is possible to increase the humus in the soil by crop rotation and diversified agriculture."

Soils from Kamerun, Senegambia, and German East Africa, and an improved method of soil analysis, F. WOHLTMANN and H. KRATZ (*Jour. Landw., 44 (1896), No. 3, pp. 211–234*).—Analyses of 5 Kamerun, 3 French Senegambia, and 17 German East Africa soils are reported and the results are discussed at some length. The Kamerun soils were found to be much superior to the others.

The essential features of the method of analysis used are as follows: Put the soil through a 2-millimeter sieve, reducing the lumps with the hand or with a wooden pestle. To 450 gm. of this fine soil add 1,500 cc. of cold hydrochloric acid (1.15 sp. gr.) and let stand 12 hours in the cold, shaking hourly. Then let stand over night and repeat the same treatment during the next 24 hours. Filter off 1,000 cc. of the solution and determine the acid soluble constituents in the filtrate in the usual manner.

In these analyses determinations were made of silica, lime, magnesia, phosphoric acid, potash, iron, and alumina in the acid extract, and water, volatile and combustible matter, and total and ammoniacal nitrogen in the original soils.

A brief discussion of the cultivated soils of Courland and Livonia based on examinations made by the Riga Polytechnic Institute, C. THOMS (*Jour. Landw., 44 (1896), No. 4, pp. 311–332*).—This is a review and continuation of previous investigations along this line (E. S. R., 7, p. 663). The additional data relate especially to the phosphoric acid of Livonia soils. The results of examinations of these soils confirm those obtained on the Courland soils, viz, that productiveness runs parallel with the phosphoric acid content of the soils.

The climate of Geneva, New York: Soil temperature observations, P. COLLIER (*New York State Sta. Rpt. 1894, pp. 138–140, 147, 148, 780–785*).—Observations at 8 different depths (1–24 in.) during the growing season (April–October) of the past 12 years are tabulated and compared with air temperatures of the same period. It was observed that the average monthly temperatures at each depth were approximately the same and not materially different from that of the air.

"The average daily temperature taken at 12 m. is higher for depths of 1 and 2 in. than the observations at 6 p. m., but at depths of 3 in. and more the 6 p. m. observations are the highest of the day, and this is true whatever the month of observation.

"At depths of 18 and 24 in. the temperatures are constant throughout the day, whichever month is considered.

"While the general daily average of all the months is nearly the same for each depth, it is found that there is a general increase, though slight, in the temperatures as [the depth increases]. . . .

"An excess of temperature beyond a depth of 3 in. was found in the months of August, September, and October, thus showing that in the latter portion of the season a large reserve of heat has been stored up in the soil."

A detailed daily summary of observations at the different depths during 1894 is given.

Analyses of water, H. J. WHEELER (*Rhode Island Sta. Rpt. 1895, p. 294*).—Tabulated analyses with reference to sanitary condition of 12 samples of water.

Analyses of waters, M. B. HARDIN (*South Carolina Sta. Rpt. 1895, pp. 58–61*).—Complete mineral analyses of 15 samples of mineral water, and examinations with reference to sanitary quality of 26 samples of drinking water.

Influence of climate on agricultural soils of Tunis, L. MARCASSIN (*Bul. Agr. et Commerce, Tunis, 1 (1896), No. 1, pp. 16–23*).—A general discussion of the climatic and soil conditions of this region, with suggestions as to needed investigations bearing on the relation especially of water to plant production in this dry climate where irrigation is a necessity.

A new contribution to the study of fallowing, P. P. DEHÉRAIN (*Ann. Agron., 22 (1896), No. 11, pp. 515–523*).—Experiments during the last year indicated that there was much more water as well as a larger production of nitrates in the soil lying fallow than in that bearing plants.

The oxidation of the organic matter of the soil, P. P. DEHÉRAIN and E. DEMOUSSY (*Ann. Agron., 22 (1896), No. 7, pp. 305–337, fig. 1*).—A detailed account of experiments previously briefly reported (E. S. R., 8, p. 208).

Concerning nitrate formation, A. STUTZER and R. HARTLEB (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 22, p. 701*).—A preliminary note.

Denitrifying bacteria, A. VOGEL (*Apoth. Ztg., 11, p. 704; abs. in Pharm. Rev., 14 (1896), No. 12, pp. 279, 280*).

On denitrification, G. AMPOLA and E. GARINO (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 21, pp. 670–677, fig. 1*).

The distribution of salts in alkali soils under different conditions, E. W. HILGARD (*Forsch. Geb. agr. Phys., 19 (1896), No. 12, pp. 20–36, figs. 5*).—The main points of this article have been covered by the author in previous papers (U. S. Dept. Agr., Office of Experiment Stations Bul. 30, p. 66; U. S. Dept. Agr. Yearbook 1895, p. 103; California Sta. Bul. 108 (E. S. R., 7, p. 568); Pop. Sci. Monthly, 48, p. 602).

The conditions of the formation of natural soda, II, P. MELIKOFF (*Abs. in Bul. Soc. Chim. Paris, 15–16 (1896), No. 23, p. 1866*).

Texture of some important soil formations, M. WHITNEY (*U. S. Dept. Agr., Division of Agricultural Soils Bul. 5, pp. 23, pls. 35*).—This bulletin gives a brief discussion of the relation of soils to crop production, pointing out especially the importance of physical condition and water supply, and a number of photographs illustrating in a graphic way the texture of some important types of soil, with a brief descriptive text. The plates show the percentages of gravel, sand, silt, and clay in truck lands of East Hartford, Connecticut; Marley and Salisbury, Maryland; Boston, Massachusetts; Jamaica, Long Island, New York; Newbern, North Carolina; Providence, Rhode Island, and Norfolk, Virginia; wheat land of Davidsonville, Maryland; grass land of Hagerstown, Maryland; upland loess of Virginia City, Illinois; loess of Nemaha County and Geneva, Nebraska; plains marl of Cheyenne County, Kansas, and Ogallala, Nebraska; tobacco lands of East Hartford and Poquonock, Connecticut; Hatfield, Massachusetts; Lititz and Marietta, Pennsylvania; Vuelta Abajo district, Cuba; and Rimboen estate, Sumatra; bright tobacco lands of Granville County, North Carolina; Lancaster, South Carolina; Green County, Tenn ssee, and Danville, Virginia; shipping tobacco lands of Newstead, Kentucky, and Clarksville, Tennessee; White Burley tobacco land of Lexington, Kentucky; Remedios tobacco land of Camajuani, Cuba; and barren clay hills of the Potomac formation, near Baltimore, Maryland. The appearance of soil particles in flocculated and unflocculated condition, and the percentages of water maintained in truck, wheat, and grass lands are also shown. It is shown that the truck soils examined maintained on an average 6 per cent of moisture, the wheat soils 13, and the grass soils 18.

Notes on Hilgard's elutriation process for soils, A. MAYER (*Forsch. Geb. agr. Phys., 19 (1896), No. 3, pp. 193–211, figs. 2*).—The comparative merits of the methods of Hilgard and Schöne are discussed.

FERTILIZERS.

The value of the manure from animals fed on linseed meal, H. SNYDER (*Minnesota Sta. Bul. 47, pp. 23, 24*).—In a pig-feeding experiment with linseed-oil meal and potatoes, mentioned elsewhere (p. 615), 2 lbs. of manure and 6 lbs. of urine were produced daily per pig (weighing 175 lbs). This dung and urine contained 0.09 lb. of nitrogen, while the food eaten contained 0.1 lb.

It is stated that under present systems of management only about one-tenth of this nitrogen would be returned to the soil, but that with proper care the greater portion of it might be utilized.

Under such conditions, it is claimed, flax raising, like wheat raising, might be made the means of keeping up the fertility of the soil instead of exhausting it. "The linseed meal should be fed at home, and this fertility, as well as the fertility in bran and shorts, retained."

The so-called "natural plant food" a soft phosphate, A. D. SELBY (*Ohio Sta. Bul. 71, pp. 178–184*).—Analyses are reported which clearly indicate that the "base" of this mixture is "Florida or possibly the Tennessee soft phosphates." As bearing upon the claims of the manufacturers that the material hastens germination, experiments were made in a greenhouse with wheat planted in unfertilized soil and soil to which soft phosphate, dissolved South Carolina phosphate, Thomas slag, and dissolved boneblack were added.

"The soft phosphate evidently retarded germination slightly, while some of the other fertilizers used showed a more marked retarding effect upon seed germination compared with germination of seed in unfertilized rows. There is a suggestion of possible value in these results."

The rôle of sulphate of iron, COSTE-FLORET (*Prog. Agr. et Vit., 26 (1896), Nos. 42, pp. 434–440; 43, pp. 463–467; 44, pp. 496–504*).—This is a review of work on sulphate of iron as a fertilizer and as a remedy or preventive for plant diseases.

It is claimed that the results favorable to this substance as a fertilizer have always been obtained on calcareous soils. The sulphate has very corrosive properties, which cause large applications of it to destroy vegetation and smaller applications to retard root absorption. The latter may explain its effectiveness in certain cases against chlorosis.

Ammonium thiocyanate as an impurity in ammonium sulphate, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Rpt. 1895, pp. 281–286*).—Schumann, Wagner, Krauch, Sigmund, Wollny, and Juneau have called attention to the poisonous effects of sulphate of ammonia containing ammonium thiocyanate.

This article records the results of comparative tests on oats in galvanized-iron pots (8 in. in diameter and 14 in. deep) of white ammonium sulphate and brown ammonium sulphate (containing traces of thiocyanate) with and without the addition of lime and thiocyanate

(1 gm. and 0.5 gm. of the latter in case of the white sulphate and 0.5 gm. in case of the brown sulphate).

"[The results show that] without lime the yield where the brown ammonium sulphate was used was practically the same as from the white lot, so that if any ill effect had resulted from the use of the white product it is obvious that the ill effect from the brown lot was no greater. In fact no positive ill effect was noticed in either case. Comparing the two kinds again, where lime was used with each the results were practically the same, for we have 31.2 gm. from the white ammonium sulphate and 30.4 and 31.6 gm. from the brown, so that whether used with or without lime it gave results fully equal to the product which was free from ammonium thiocyanate. Where ammonium thiocyanate was used in connection with the brown ammonium sulphate, even with lime, the yield was seriously affected. The same was likewise true where the thiocyanate was applied in connection with the white ammonium sulphate and lime, and where the larger quantity was applied . . . the weight of oats was but 7.6 gm. In view of the fact that the growth was excellent except where ammonium thiocyanate was added, and in consideration of the fact that ammonium sulphate has always worked well upon this soil after liming, the poisonous action of ammonium thiocyanate upon plants is again demonstrated."

Field experiments with fertilizers, C. E. THORNE, J. F. HICKMAN, and W. J. GREEN (*Ohio Sta. Bul. 71, pp. 109–164*).—A preliminary discussion is given of the amount of fertility removed from the soil by average crops of corn, oats, wheat, clover, and timothy grown in a 5-years' rotation; the quantity and cost of fertilizers used in the State in 1894, and the most economical means of restoring the fertility removed in crops.

"To return the fertility removed by the average crops of the rotation under consideration would require:

1,157 pounds nitrate of soda, costing	$26.00
354 pounds dissolved bone black, costing	3.20
272 pounds muriate of potash, costing	6.80
Total cost	36.00

"It will be observed that there is a wide margin between the cost of these materials and that of the ordinary mixed fertilizers as sold in Ohio, but even this cost would consume the greater part of the value of the crops produced if it were necessary to return to the soil all the nitrogen, phosphoric acid, and potash which the crops carry away. . . .

"However, no one believes that it is necessary to return to the soil all the nitrogen which the crops have carried away, however it may be with regard to the phosphoric acid and potash."

The experiments of the station were undertaken to determine (1) whether one of the essential constituents may be economically omitted from a fertilizer mixture, (2) the most economical proportion of these ingredients, (3) to what extent the use of nitrogen may be reduced by growing clover, (4) the relative powers of different crops to secure their own supplies of plant food, (5) what proportion of the fertilizing constituents applied to the soil is recovered in the crop, and (6) the best forms of the fertilizing constituents. Following is the general plan:

"Nitrogen, phosphoric acid, and potash, as carried in nitrate of soda, dissolved boneblack, and muriate of potash, are applied singly, by twos, and all three

together and in varying proportions, on plats of land selected for its natural uniformity, and so treated, by drainage and tillage, as to increase this uniformity to the utmost possible extent, these plats being duplicated on typical soils of different formations, in widely separated regions of the State.

"Nitrogen is applied to one plat in quantity sufficient to supply the full requirements of the crops to be grown, and to other plats in smaller quantity.

"The cereal crops, corn, oats, and wheat, are grown continuously on the same land, both with and without manure and fertilizers, in order to study their feeding habits, while the same crops, with the addition of potatoes, clover, and timothy, are grown in different rotations, in order both to study this question and to learn the limit of possible recovery of plant food applied in fertilizers; and finally, the constituents of fertility are applied in various forms—nitrogen in nitrate of soda, sulphate of ammonia [60–120 lbs.], slaughterhouse refuse [dried blood, 100–200 lbs.], linseed meal [250–500 lbs.] and barnyard manure [4–8 tons]; and phosphoric acid in dissolved boneblack, raw bone meal [55–118 lbs.], acid phosphate [85–170 lbs], basic slag [65–130 lbs.], wheat bran [500–1,000 lbs.] and manure."

The fertilizers were applied on the basis of 1 part of nitrogen to 1.5 parts of phosphoric acid, this being calculated to be the narrowest ratio permissible in a plan which undertakes to return the fertilizing constituents removed in the 5-crop rotation given above. The actual rates per acre were as a rule 320 lbs. of superphosphate, 480 lbs. of nitrate of soda, and 260 lbs. of muriate of potash, it being estimated that these amounts "would furnish as much phosphoric acid and nearly as much nitrogen as are contained in an increase of 13 bu. of wheat, 27 bu. of corn, and 28 bu. of oats, with their straw and stalks, and phosphoric acid to spare sufficient for 4,000 lbs. of mixed clover and timothy hay, leaving the nitrogen in the hay crops unprovided for."

The proportions were varied somewhat in different cases, and the other fertilizing materials named were substituted in some cases.

"The work is now located in four sections of the State, as follows:

"(1) At the central station at Wooster, on a light, yellow clay or clay loam, lying over Waverly shales. About 30 acres of land are now under experiment with fertilizers here, all being divided into plats containing one-tenth acre each, the plats being 16 ft. wide and separated by vacant spaces 2 ft. wide. Under every second vacant space a tile drain is laid, the drains thus being 36 ft. apart. They are laid about 30 in. deep.

"Two rotations are in progress here, one of the 5 crops, corn, oats, wheat, clover, and timothy, and one of potatoes, wheat, and clover, each crop being grown but 1 year in the rotation. In addition to these rotation experiments, 1 acre each is devoted to the continuous culture of corn, oats, and wheat, both with and without manure. Neither of these rotations has yet been completed, the first having been begun in 1893, the second in 1894.

"(2) The work on the farm of the Ohio State University, begun by the station in 1888, is still continued under the station's management, through the coöperation of the farm department of the University. In this work about 7 acres are used in the continuous culture of corn, oats, and wheat, and about 3 acres in a rotation of these crops with clover and timothy.

"The soil here is a heavy clay, the portions devoted to wheat and to crop rotation lying upon the impervious Huron shale, while that in continuous culture of oats and corn is underlaid with gravel. The whole tract is platted and underdrained as at the central station, except that the rotation plats contain but one-twentieth acre each.

"(3) An experiment in the continuous culture of corn on the same land was begun under direction of the station in 1888 in Columbiana County, on a tract of thin clay lying over porous shales, and is still continued.

"(4) A substation for field experiments has been located in Fulton County, near the corners of Lucus and Henry counties, the post-office being Neapolis, Lucas County. The soil of this substation is the barren, yellow sand of the ancient lake beach, and the region in which it is located is celebrated for its sterility, lands being offered for sale as low as $5 to $10 per acre. It is locally known as the "Oak Openings," the timber being a scattering growth of oak. Forty acres of new land have been taken under lease and cleared of timber, and about 10 acres divided into plats of one-twentieth acre each, on which a 3-crop rotation of potatoes, wheat, and clover was begun in 1894.

"In this region one of the main problems seems to be to amend the physical condition of the soil, as in its natural condition its fertility leaches rapidly and its loose sands are badly drifted by the wind. When first brought into cultivation the yellow sands of this region produce extremely meager crops, but when farmed in rotation with clover, and especially if sheep are kept, they improve in productiveness.

"This is known as the northwestern substation.

"(5) A northeastern substation has been established in Strongsville township, Cuyahoga County, this being the southwestern township of the county, and near the boundaries of Medina and Lorain counties. The soil here is the heavy, white clay, which characterizes a large portion of the Western Reserve region—a soil which, in its natural state, is one of the least responsive to culture of any in Ohio. A tract of 100 acres, lying a mile west of Strongsville village, has been leased, and work was begun on it in the Spring of 1895. Part of this land is an old field which has not been cultivated for many years, and which was covered with a dense growth of spiked wild oat grass (*Danthonia spicata*) locally known as 'poverty grass,' and considered almost absolutely worthless, either for pasture or hay—a grass which has established the reputation of growing on 'hard clay lands where nothing else will.'[1]

"On this section has been commenced a 5-crop rotation of corn, oats, wheat, clover, and timothy, while on another part of the tract, which has been in regular cultivation, has been started a 3 crop rotation of potatoes, wheat, and clover, the first crop on each rotation being grown in 1895. This tract, like those at the central station and on the University farm, is being underdrained with tile drains laid 36 ft. apart and about 30 in. deep.

"In all this work every third plat has been left continuously unfertilized, beginning with the first in each series."

The yields (during 1894 and 1895) are given for the different crops grown continuously and in rotation. These include oats, corn, wheat, and clover in rotation at Wooster and Columbus; potatoes and wheat in rotation at Wooster and in Fulton and Cuyahoga counties; wheat, oats, and corn grown continuously on the same land at Columbus and in Columbiana County (E. S. R., 6, p. 211).

The crops were seriously injured in 1894 by drought and other unfavorable conditions, and the effect of fertilizers was therefore not apparent. In 1895 the crops also suffered some from drought, especially on uplands.

The results at Wooster during this year show that "there was an increase in yield wherever superphosphate was used, the increase being generally small and irregular. Nitrate of soda and muriate of potash,

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[1] U. S. Dept. Agr. Rpt. 1879, p. 355.

when used alone or in combination with each other, but without phosphoric acid, seem to have reduced the yield, but when either or both of these were added to superphosphate the yield was generally increased beyond that from the superphosphate alone."

The superphosphate appeared to increase the proportion of straw in the case of wheat.

The general results of these experiments are summarized as follows:

"The experiments herein reported, which have now extended over 8 seasons on 2 separate tracts of land, and over 2 seasons on 2 other tracts, all widely diverse in location and character of soil, indicate that the highest efficiency of a fertilizer for cereal crops or potatoes is only attained when it contains all three of the chief constituents of fertility, nitrogen as well as phosphoric acid and potash.

"In the absence of clover or other leguminous crops, the maximum increase has been produced when the quantity of nitrogen applied was equal to or greater than that of phosphoric acid.

"The work has not yet gone far enough to give definite information concerning the effect of clover or other leguminous crops in the rotation, but at the present stage of the work it seems doubtful whether clover can be relied upon to furnish sufficient nitrogen for maximum crops, grown in rotations of 5 years or more.

"It appears that corn, and possibly potatoes, have a far greater capacity for obtaining plant food than wheat or oats, the statistics of crop production showing that an average crop of corn may obtain nearly twice as large a total quantity of nitrogen, phosphoric acid, and potash as an average crop of wheat or oats, grown under the same conditions of soil and climate.

"Where the cereal crops have been grown in continuous culture for 7 or 8 years in succession, the total recovery of plant food, applied in chemical fertilizers, by the crops to which they were applied, has been about one-third the nitrogen and one-eighth the phosphoric acid and potash. Where they have been grown in rotation with clover, 50 per cent more nitrogen was recovered in the increase than was applied in the fertilizer, but only one-sixth as much phosphoric acid and half as much potash.

"The immediate increase from barnyard manure has been much smaller in proportion to its chemical constituents than from the chemical fertilizers used in these tests; but the residual effect of manure is shown to be much greater than that from chemicals.

"Nitrate of soda has been the most effective carrier of nitrogen in these experiments, with sulphate of ammonia, dried blood, and linseed-oil meal but little inferior. Of the various carriers of phosphoric acid, dissolved boneblack, acid phosphate, and basic slag seem to produce practically equal results, pound for pound of phosphoric acid contained. . . .

"With fertilizers rated at the prices which Ohio farmers have been paying for them, and with the increase valued at the average market prices of recent years, the cost of the fertilizer has never been recovered in the direct increase, when used on cereal crops, except in a few instances which have not been repeated in subsequent crops.

"When the cereals have been grown in rotation with clover there has been a larger increase, from one-third to one-half the total recovery of plant food being found in the hay crops, and when fertilizers have been used on potatoes there has been a good profit, with ordinary yields and average prices of potatoes."

On the substitution of soda for and its value in connection with potash, H. J. WHEELER and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 215–231*).—Investigations in this line commenced in 1894 (E. S. R., 7, p. 849) were continued in 1895.

"The results of the experiments have shown in 1895 even more conclusively than in 1894 that applications of soda without potash have been upon our soil far less beneficial than applications of potash without soda. The indications of this season's results, like those of 1894, are to the effect that increasing quantities of potash when applied in connection with a given amount of soda show a greater benefit than increasing quantities of soda applied in connection with a given amount of potash. In the case of mangel-wurzels and lettuce a slightly greater advantage seems to have been derived from the use of the carbonates of potash and of soda than from the chlorids of the same, a difference which there is every reason to believe would have been much greater had the applications of potash and soda been largely increased. Air-slacked lime, as has been observed in other experiments, has had a wonderfully beneficial effect in connection with certain plants, which has been attributed by us not only to its direct fertilizing action, but also largely to its having overcome the acidity of the soil, or to its having effected the decomposition of constituents of the same which exerted an injurious influence upon the growth of certain plants. . . .

"In the experiment with sodium salts a trial was made of the relative effectiveness of chlorids of potassium and sodium, and of the carbonates of the same. Since nitrate of soda is an ingredient of most commercial fertilizers, and because special claims have been made for the fertilizing value of the soda which it contained, it has been thought desirable to compare its action with that of nitrate of potash. In order to do this upon a proper basis, it was necessary to use an amount of nitrate of soda which would furnish an amount of nitrogen exactly equal to that contained in the nitrate of potash, and also to use a quantity of potash in connection with the nitrate of soda which would be identical with that contained in the nitrate of potash. As a source of potash for this purpose the muriate of potash was employed. The experiment was also so arranged that comparisons as above mentioned could be made upon unlimed plats, upon those which had received land plaster (gypsum) and air-slacked lime."

The results of these experiments (on beets) are tabulated, but are inconclusive. The experiments are to be continued.

Further observations upon the growth of various plants upon an upland acid soil before and after liming, H. J. WHEELER and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 205-214, pls. 3*).—These observations were in continuation of those recorded in the Annual Reports of the station for 1893 and 1894 (E. S. R., 7, pp. 377 and 850).

"Some modifications of the previous manuring were made in 1895, as follows: Owing to the known deficiency of phosphoric acid in this soil, the amount of dissolved boneblack was increased from 600 to 800 lbs. per acre; the amount of muriate of potash was increased from 180 to 350 lbs. per acre; the amount of nitrate of soda remained the same as in 1894, while the quantity of ammonium sulphate, which varied slightly in composition from that previously used, was so modified that the amount of nitrogen furnished by it would be identical with that applied in the nitrate of soda."

The 2 limed plats of the series received 5,400 lbs. per acre of lime in 1893 and 1,000 lbs. in 1894, but no further application in 1895.

"In 1895 sulphate of magnesia (epsom salts) was applied to all at the rate of 200 lbs. per acre. This was done for the reason that previously better results were obtained from the limed plat which received nitrate of soda than from the other limed plat, which received sulphate of ammonia—differences which might have in part been attributed to the liberation of magnesia by the soda. The particular feature of the experiment as conducted in 1895 has been the introduction of the test of the effect of liming upon the development of a number of the more important grasses which are already, or might, perhaps, be grown to advantage in this State. . . .

"A number of miscellaneous plants which have been grown on one or two previous occasions have been retested in order that the data in relation to them might be increased to such an extent as to render the conclusion drawn of greater value than would otherwise be possible."

The results are tabulated and illustrated. The following summary is given:

"The following vegetables have shown this season benefit from liming, decreasing in the following order: Onions (Egyptian), celery, onions (Barletta), pumpkins, mangel-wurzels, muskmelons, carrots, table beets, dandelions, cabbages, kohl-rabi, and flat turnips.

"Carrots and pumpkins, which showed an apparent injury from lime in 1894, have given an increase upon the limed plats in 1895. It is possible that these two plants should be introduced into a rotation a year or two after the lime has been applied in order to secure the best results, a point which can only be ascertained with certainty by further experiments.

"The watermelon showed a decided injury from liming in 1894, which was even more marked in 1895. In this particular the watermelon stands in marked contrast to the muskmelon, which was practically a failure both years except upon the limed plats.

"Alfalfa, like clover, has shown a decided benefit from liming, while serradella and blue lupine have, on the contrary, been injured thereby. The injury to the lupine has been observed in each of the 3 years of the experiment, though it was greatest in 1894, immediately following the second application of lime.

"Common sorrel has shown an injury from liming during both of the years in which it has been grown, though the injury was greatest in 1894, immediately following the second application of lime.

"The observations with the different grasses indicate that timothy, Kentucky blue grass, awnless brome grass, and others may be benefited by lime in varying degrees, while the sweet vernal, soft grass, Rhode Island bent, and sheep's fescue indicate less or no benefit from its use. These results with grasses, as has been stated previously, are those obtained from the first season's growth, and can not therefore be so conclusive or satisfactory as the results of succeeding seasons. It appears probable, however, that the individuality of the grasses in respect to their benefit or injury from liming may be as great as that of the individual members of the leguminous, melon, and other families of plants."

Experiments with various kinds of barnyard manure alone and compared with nitrate of soda, sulphate of ammonia, and urine, MAERCKER (*Jahrb. Agr. Chem. Vers. Stat. Halle 1895, pp. 57–69; abs. in Deut. landw. Presse, 23 (1896), No. 98, p. 871, fig. 1*).—A summary is given of pot experiments with 2 samples of deep-stall sheep manure and 4 samples of ordinary barnyard manure. The sheep manure approached the ideal in composition[1] and compared very favorably with sulphate of ammonia and nitrate of soda on oats. The barnyard manures, on the other hand, were either without effect or lowered the yield. It is suggested that this was due to the reduction of nitrates by the organisms of the manure.[2]

Comparative action in granitic soils of different phosphatic fertilizers on the cultivation of potatoes, G. BATTANCHON (*Prog. Agr. et Vit., 26 (1896), No. 30, pp. 96–99*).—Two mineral phosphates, Thomas slag, precipitated phosphate, and superphosphate were tested on plats, all of which had received a dressing of barnyard manure and a basal

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[1] Having 70 per cent of its nitrogen readily available, *i. e.*, furnished mainly by urine.

[2] See also E. S. R., 7, p. 754.

fertilizer of nitrate of soda and muriate of potash. The experiments were in two series, one on coarse granitic soil and the other on finer granitic soil. The slag and mineral phosphates produced only insignificant results on the first soil, but were more effective on the second.

Commercial fertilizers, P. COLLIER and L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 149–170, 526–569*).—This includes the text of the State fertilizer law as amended May 9, 1894; discussions of the quality of wood ashes offered on the market, of the amount and average composition of the fertilizers sold in New York during 1894, and of the advantages of home-mixing fertilizers; notes on valuation; a list of manufacturers offering fertilizers for sale in the State in 1894, and tabulated analyses of 330 samples of fertilizers, reprinted from Bulletins 73 and 85 of the station (E. S. R., 6, p. 287; 7, p. 211).

From replies to a circular of inquiry addressed to fertilizer manufacturers it is estimated that the total amount of fertilizers sold in the State in 1894 was 59,528.9 tons, 48,350.5 tons of which was complete fertilizers.

Wood ashes.—Compiled analyses from different sources are reported, to show the wide variation in the commercial product.

In order to determine the amount and the quality of the ashes produced by different kinds of woods "in a manner comparable with actual practice, about an equal weight each of 19 varieties of air-dried hard and soft woods were taken, and each lot was burned in a furious fire in an open hearth."

The results obtained were as follows:

Amount and composition of ashes of hard and soft wood.

Kind of wood.	Ashes.	Composition of ashes.			
		Phosphoric acid.			Potash.
		Available.	Insoluble.	Total.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hard wood	0.64	1.25	0.75	2.00	13.09
Soft wood	.51	1.47	.63	2.10	6.94

"In order to determine the approximate loss by burning at the high temperature of the hearth, approximately equal quantities of the same woods were taken and incinerated at a very low temperature, and there was found in the ashes of the hard woods 17.35 per cent of potash and in the ash of the soft woods 9.61 per cent of potash.

"From the above results it will be clearly seen that pure, unleached, hard-wood ashes, of which we hear so much, is an evanescent dream and a fiction, for there is nothing approaching it found in the markets.

"While it is probably true that ashes are bought for, and their beneficial effects is mainly due to, the potash they contain, it is clear that the potash is thus obtained at an excessive price as compared with its commercial value in the several potash salts of the German mines, but it must not be forgotten that the other constituents of ashes have an agricultural value, direct or indirect, which may often justify their application even at their present prices and average composition; but it is important for the purchaser to remember that there is really no significance in the term 'pure, unleached ashes,' and a guaranteed percentage of potash, as also freedom from any adulteration, should be insisted upon, since it would be an easy matter to increase the percentage of potash by admixture with a sufficient quantity of the cheaper potash salts."

Composition and valuation of the fertilizers sold in the State in 1894.—The following table shows the average actual and guaranteed composition of all fertilizers examined by the station during the spring of 1894, and also of the 179 brands of which the selling price was ascertained:

Average composition and selling price of fertilizers in New York, 1894.

	253 analyses.	179 analyses.
	Per cent.	*Per cent.*
Nitrogen, maximum amount guaranteed	3.597	3.507
Nitrogen, minimum amount guaranteed	2.827	2.753
Nitrogen, amount found by analysis	3.021	2.942
Available phosphoric acid, maximum amount guaranteed	10.149	10.137
Available phosphoric acid, minimum amount guaranteed	7.992	8.059
Available phosphoric acid, amount found by analysis	8.334	8.333
Total phosphoric acid, maximum amount guaranteed	13.000	12.509
Total phosphoric acid, minimum amount guaranteed	12.325	10.221
Total phosphoric acid, amount found by analysis	12.943	10.830
Potash, maximum amount guaranteed	5.700	5.576
Potash, minimum amount guaranteed	4.905	4.862
Potash, amount found by analysis	5.317	5.279
Average selling price to farmers	....	$32.25

Giving to each constituent its maximum market price, viz, nitrogen 18½ cts., available phosphoric acid 5½ cts., insoluble phosphoric acid 2 cts., and potash 4½ cts., the average valuation of the 179 fertilizers is $25.80, 25 per cent less than the average selling price, $32.25.

"Recent quotations show that potash as high-grade muriate can be landed in Geneva, by the ton, at not exceeding 4¼ cts. per pound, nitrogen as nitrate of soda at 15⅞ cts. per pound, and soluble phosphoric acid at 5 cts. per pound.

"At these prices our average fertilizer would cost $21.77 per ton instead of $25.80, and there would be a saving of $10.48 per ton, which would well pay for the cost of mixing. . . .

"It is obvious that there is room for a very considerable saving in cost provided a few enterprising farmers unite and mix their own fertilizers."

An examination of 41 brands of so-called special manures for potatoes, 8 for tobacco, and 12 for cabbages showed that there was nothing approaching agreement in the composition of different brands designed for the same purpose, except the presence of all three fertilizing constituents.

Formulas are given by which fertilizers approximating in composition the averages of the above classes may be compounded. Using the cost of these mixtures as a basis and allowing $3.50 for freight to the central part of New York, the following average results in selling price, cost of making, and amount saved per ton are obtained:

Average selling price and cost of fertilizers.

	Selling price.	Cost of making.	Difference.
Average of 235 fertilizers	$32.25	$24.58	$7.67
Average of 41 potato manures	35.34	23.60	11.74
Average of 8 tobacco manures	32.33	23.54	8.79
Average of 12 cabbage manures	36.88	30.70	6.15

"It is of course to be kept in mind that in the above mixed fertilizers, the preparation of which has been explained, there have been used in every case the very best chemicals to be found in the maket."

The sources and cost of fertilizing materials, C. E. THORNE, J. F. HICKMAN, and W. J. GREEN (*Ohio Sta. Bul. 71, pp. 164–170*).—A popular discussion of this subject.

The home-mixing of fertilizers, C. E. THORNE, J. F. HICKMAN, and W. J. GREEN (*Ohio Sta. Bul. 71, pp. 170–178*).—"It is shown that persons may save from 30 to 50 per cent of the cost of their fertilizers by purchasing the materials and mixing them (when mixing is necessary) at home." Directions and formulas are given.

A critical discussion of the more important methods of preserving manure, F. TAUBKE (*Fühling's landw. Ztg., 45 (1896), No. 22, pp. 696–710*).

A new preservative for manure, GERLACH (*Landw. Centbl. Posen, 24 (1896), No. 42, p. 234*).—An account is given of tests of a proprietary compound containing from 87 to 90 per cent of gypsum, 10 per cent of crude acid (5 per cent sulphuric acid), and 1 to 3 per cent of soluble phosphoric acid. Used in the amount recommended the preservative was not effective, but was very expensive.

The effect of lime in slag, W. SOMERVILLE (*Agl. Gaz. (London), 44 (1896), Dec. 28, p. 567*).

Marl and marling, HEINRICH (*Mergel und Mergeln. Berlin: Parey, 1896*).

Lime and marl, TANCRÉ (*Landw. Wochenbl. Schles. Holst., 46 (1896), No. 51, pp. 735–740*).

Phosphatic fertilizers, L. VANDENBERCH (*Belg. Hort. et Agr., 8 (1896), No. 24, pp. 375, 376*).—A popular article.

Ordinary vs. dried superphosphate, L. DECOUX and L. DRUMEL (*Ing. Agr. Gembloux, 7 (1896), No. 4, p. 110; abs. in Chem. Ztg., 20 (1896), No. 102, Repert., p. 307*).—In experiments on oats both gave a decided increase of both straw and grain. The ordinary superphosphate gave as good results as the dried and was much cheaper.

Field experiments with Thomas slag from different sources, E. PROSKOWETZ (*Mitt. Ver. Förd. landw. Versuchswesens. Oesterr., 11 (1896), No. 1, pp. 36–39*).—The results of comparative tests of 3 samples of slag with different amounts of citrate-soluble phosphoric acid on sugar beets, clover, and meadows show that the largest yields were obtained where the slags containing the greatest amount of citrate-soluble phosphoric acid were used.

Manurial experiments in Staffordshire (*Agl. Gaz. (London), 44 (1896), Dec. 28, p. 567*).

Fertilizer analyses, R. C. KEDZIE (*Michigan Sta. Bul. 135, pp. 15*).—The usual explanatory notes, including the text of the fertilizer law, and tabulated analyses of 60 samples of fertilizers collected in Michigan in 1896.

Analyses of fertilizers and fertilizing materials, M. B. HARDIN (*South Carolina Sta. Rpt. 1895, pp. 54–58, 61–63*).—Tabulated analyses of 16 samples of fertilizing materials, including acid phosphate, mineral phosphates, floats, cotton-seed meal, cotton hull, muriate of potash, sulphate of potash, kainit, and wood ashes, and the average composition in 1894 and 1895 of the acid phosphates with and without potash, nitrogenous superphosphates, kainit, and cotton-seed meal examined by the station.

FIELD CROPS.

On the relative growth of common sorrel (Rumex acetosella) and clover upon an upland acid soil before and after liming, C. O. FLAGG, H. J. WHEELER, and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 193–199, figs. 4*).—The 11 twentieth-acre plats discussed in this article had annually received since 1890 equal amounts of potash and phosphoric acid. Nitrogen had been applied in the form of nitrate of soda, sulphate of ammonia, and dried blood in from one-third to full applications. In 1893 the southern third of all the plats had been limed at the rate of 2½ tons per acre. Corn had been grown on these plats

for 4 years previous to 1894, when it was seeded to oats and clover. The weights of clover, with some timothy grown on the southern third or limed ends of the plats, are tabulated; but on the unlimed portions there was little or no timothy and very little clover, "the land being occupied by weeds, consisting chiefly of sorrel." From the tabulated yields of clover "and the accompanying illustrations the almost marvelous effect of lime upon the growth of clover upon this soil is readily seen."

The relative amounts of clover, sorrel, timothy, and miscellaneous weeds on different plats was determined from small representative areas.

"Upon the unlimed portions there was 3½ times as much sorrel with a full application of sulphate of ammonia as with full applications of nitrate of soda and dried blood."

Many volunteer clusters of timothy grew on the limed portions, but none on the unlimed sections. "The value of lime in connection with timothy upon our acid soil was therefore most strikingly manifest and was in full accord with the results secured with it in the experiment with grasses upon limed and unlimed soil described elsewhere in this report."

The author concludes as follows:

"The growth of clover upon the plats which had received no nitrogen in any form, at least for 5 and probably for a dozen years, was nearly if not quite as good as upon those which had received a large annual application from 1890 to 1894, inclusive, a result decidedly in contrast to those secured with Indian corn and oats upon the same plats.

"The injury liable to result to a clover crop owing to the smothering of the young plants by the lodging of the accompanying grain crop, the necessity for thin seeding, and care not to employ too much nitrogen in such cases is pointedly illustrated.

"Fresh applications of lime have appeared in other experiments to be unfavorable to the growth of sorrel. It appears probable, however, that the chief value of lime in eradicating sorrel is attributable to the fact that it brings about physical and chemical soil conditions, one or the other or both of which are so highly favorable to the growth of clover and many other agricultural plants that they are able to occupy the land, thereby preventing sorrel from gaining a foothold."

Indian corn experiment, C. O. FLAGG and G. M. TUCKER (*Rhode Island Sta. Rpt. 1895, pp. 312–316, figs. 3*).—November 23, 1894, 25-pound samples of each of 5 varieties of unshelled corn were hung in a corncrib; March 25, 1895, these samples were weighed. The results are shown in the following table:

Shrinkage of unshelled corn from fall till spring.

Name of variety.	Weight November, 1894.	Weight March 25, 1895.	Shrinkage.	Weight of shelled corn March 25, 1895.	Proportion of—	
					Shelled corn.	Cob.
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*	*Per cent.*
Rhode Island Capped, White Flint	25	20.00	20	17.25	86.25	13.75
Huron Pure Yellow, Dent	25	19.75	21	16.00	81.01	18.99
Minnesota King, Dent	25	23.00	8	18.50	80.43	19.57
Conqueror, Dent	25	23.25	7	18.50	79.56	20.44
Early Mastadon, Dent	25	19.50	22	15.00	77.44	22.56

The Rhode Island Capped corn gave the largest proportion of corn to cob and the shelled corn was much drier, both at time of harvest and when shelled. The authors state that with equal amounts in the fall this variety will yield more shelled corn than the others.

Extra early Leaming corn planted May 11 on well manured land and cut September 27 yielded 115.7 bu. of shelled corn and 6.3 tons of stover per acre, while Rhode Island Capped corn on land not so rich produced 62.27 bu. of shelled corn and 1.96 tons of stover per acre.

Tabulated data are given on the shrinkage of Leaming and Rhode Island Capped corn during 4 months, which for unshelled corn was 13.50 and 7.50 per cent respectively, and for shelled corn 14.40 and 7.40 per cent. It required in October 82.10 and 73.50 lbs. of ears respectively to give 56 lbs. of shelled corn in February.

Crimson clover, F. W. RANE (*New Hampshire Sta. Bul. 37, pp. 41–44*).—A popular bulletin on the subject. The difficulty in crimson clover culture in New Hampshire arises from winterkilling. In the experiment reported, during an open winter, about 22 per cent of the plants lived. From 10 to 16 lbs. of seed per acre are recommended. The author mentions sowing the seed in cornfields after the cultivation is finished, in gardens and orchards, and on stubble lands. It is valuable for green manuring.

The draft of flax on the soil and the composition of flax soils, H. SNYDER (*Minnesota Sta. Bul. 47, pp. 3–20, 29, 30, figs. 4, dgm. 1*).—Previous work in this line has been reported in Bulletin 13 of the station (E. S. R., 2, p. 496). At the station and at 2 other places in the State the draft of the flax crop on the soil was determined.

"Plants were analyzed at different stages of growth to determine the approximate time in the plant's development when each element was taken from the soil. Different types of both Minnesota and imported seeds were analyzed, as well as samples of the straw and flax when cut and cured as hay. The amount of oil yielded by different samples of seeds was also determined. The composition, digestibility, and food value of the linseed meal, and the loss of fertility in oil making, as well as a study of the soils best suited to flax culture [are discussed]."

Tabulated data show the amount of fertilizing ingredients removed from an acre by flax, a comparison between the fertility removed by this crop and by 9 of our common crops, and the composition of the ash of flaxseed, flax straw, and the entire plant. The following table gives the composition of the ash of flaxseed, straw, and entire plant:

Composition of the ash of flaxseed, straw, and entire plant.

	Pure ash.	Composition of ash.							
		Potash.	Soda.	Lime.	Magnesia.	Iron.	Phosphoric acid.	Sulphuric acid.	Silica.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Average of 6 samples of imported seed	3.47	27.81	1.25	10.45	17.04	0.92	40.09	2.03	0.81
Average of 6 samples of American seed	3.73	25.27	1.22	9.15	15.86	1.11	43.14	2.23	.88
Average of 5 samples of flax straw (American)	2.98	34.86	4.41	23.69	11.85	3.37	6.15	3.54	6.05
Entire plant:									
Before bloom	5.34	35.10	4.80	22.46	15.23	2.00	8.93	4.80	4.45
Seeds well formed	4.89	33.32	....	21.55	13.66	....	19.38	5.32	....
When ripe (average of 3 samples)	3.33	32.13	....	20.92	....	....	20.05	....	....

By the time that 40 per cent of the vegetable matter was formed 60 per cent of the total mineral matter and 53 per cent of the nitrogen required by mature plants had been taken from the soil. At the period of full bloom 88 per cent of the mineral matter and 80 per cent of the nitrogen had been taken up by the crop. The period of growth and maturity of the crop is ordinarily from 65 to 70 days after seeding.

"From 70 to 90 per cent of the principal elements of plant food are taken from the soil during the first 45 or 50 days. In order to furnish this plant food in so short a time the soil must be in the very best condition as to fertility."

"The best flax soils are those that contain about 25 per cent of medium sand, 20 to 25 per cent of fine and very fine sand, 35 to 40 per cent of silt, and about 12 per cent of clay." This soil should also contain from 15 to 20 per cent of available water.

When flax is cut in early bloom and cured it makes excellent hay. The seed contains on an average about 35 per cent of oil, of which 7 to 8.5 per cent remains in the cake in the old process of extraction.

In his summary the author states that flax does not remove an excessive amount of fertility from the soil; that it possesses but little power of obtaining its food from the soil; that home grown seed is equally as rich in stored up plant food as imported; that when flax is cut "on the green side of bloom," and before seed development, and cured as hay, it makes a valuable fodder; and that a yield of 15 bu. per acre will produce about 270 to 280 lbs. of crude oil by pressure process.

Forage crops, J. F. HICKMAN (*Ohio Sta. Bul. 70, pp. 81–107, pl. 4*).—In this bulletin are given the general results of experiments with forage crops at the station since 1888, including methods of soil preparation, quantity of seed used, manner of growth, length of season required, and other data. The author recommends the following: Alfalfa for lands having open or porous subsoils, cowpeas only for green manuring on impoverished land, soja bean for forage and green manuring, Canada peas and oats for forage, Indian corn as the foremost forage crop grown in Ohio, Hungarian and German millets for catch crops when the hay crop is short, and rape for forage. The hairy vetch has not been sufficiently tested. Crimson clover is regarded as of doubtful value. The flat pea, spring vetch, sweet clover, Brazilian flour corn, Kafir corn, millo maize, Jerusalem corn, teosinte, Japanese and Russian millets, sachaline, and spurry are not considered of sufficient value in Ohio to justify their recommendation.

Forage plants (*Rhode Island Sta. Rpt. 1895, pp. 316–319*).—Repeated sowings of alfalfa have been made at the station, thus far without success. Early maturing varieties of cowpeas have been sown and have made a good growth, producing pods containing apparently mature seeds which will be planted another season. Crimson clover has proven satisfactory as a catch crop and for green manuring, but it must be sown annually as it will seldom live through the winter. Egyptian lentil was grown and is considered of little value as a grain crop as

compared with Canada peas. The flat pea made an uneven growth the second season. The tops when cut were readily eaten by cattle.

Small grains, L. FOSTER (*Montana Sta. Bul. 10, pp. 27–40*).—After describing the methods of wheat culture in common use in Montana the writer gives the details of a test of varieties of wheat. Six rows, 14 in. apart and 8 rods long, were sown to each variety tested, of which there were 86. The results are tabulated. Analyses are also given of 29 varieties, showing the percentage of water, nitrogen, and crude protein. The Ladoga wheat is especially mentioned.

The yields of 50 varieties of oats and 27 of barley are tabulated. The seed of both grains was treated for smut by dipping in a solution of copper sulphate. There was no smut in the barley and only an occasional head in the oats.

Beginning August 9 a small plat was sown to spring wheat each week until November 19. Only the latest sowings were free from winterkilling. The first 6 plats averaged 3.3 bu., the next 5, 12.7 bu., and the last 4, 38.5 bu.

Leguminous and other plants grown without and with different quantities of nitrogen (*Rhode Island Sta. Rpt. 1895, pp. 319–326, figs. 10*).—The trial was on 3 plats which for two seasons had received like amounts of potash and phosphoric acid, 2 receiving also 150 lbs. and 450 lbs. of nitrate of soda, respectively. Leguminous crops had been grown, but in the present trial various nonleguminous crops were grown. The results are tabulated. The plat with no nitrogen produced more than half as much spring rye, oats, field corn, and Golden Wonder millet as the plat with the full application of nitrogen. The plat with the smaller application of nitrogen produced more than 80 per cent of the amount yielded by the plat with the full application in the case of every crop except barley. In the case of Japanese millet the plat with the smaller application of nitrogen gave fully one-fourth more crop than the plat with the full application. With regard to leguminous plants only one, the Japanese bean called "Edamame," gave greater yields upon the no-nitrogen plat and the plat with the smaller application of nitrogen than upon the plat with the full application. The author concludes that the larger amount of nitrogen was generally not profitable.

Experiments on permanent grass in Gloucestershire, 1896 (*Agl. Students' Gaz., n. ser., 8 (1896), No. 2, pp. 41–43*).—Comments and tabulated details are given for experiments on 32 twentieth-acre plats of permanent mowing land with rape-cake meal, basic slag, nitrate of soda, ammonium sulphate, guano, superphosphate, kainit, and salt, singly and in various combinations. Fourteen of the plats had received a dressing of 7 tons per acre of colliery dung in the previous December and were partially flooded by the overflow of a stream about the middle of May.

"[On this series of plats] superphosphate alone had no effect, but kainit alone was beneficial; kainit and superphosphate together more so; rape-cake meal gave

only a small increase, but of good quality; guano gave an excellent crop of fine quality; and ammonium sulphate alone a splendid crop of good mixed grasses. . . . Common salt at the rate of 200 lbs. per acre gave an increased yield of 500 lbs. of hay, and favored the finer grasses."

The other series of plats were upon drier land and were affected by drought. Upon these plats superphosphate and kainit, singly or together, produced little effect.

"Guano gave a small increase, but of good bottom and fine grasses; rape-cake meal gave a good increase of fair quality; sodium nitrate alone and ammonium sulphate alone in equivalent quantities gave the same amount of increase, but the quality of the produce of the ammonium sulphate plat was rather better. The best results were obtained by a mixture of cinereals with nitrogenous manure, and generally the mixtures containing ammonium sulphate gave heavier crops and of a rather better quality than those containing sodium nitrate."

The residual value of manures applied to the hay crop, as shown in the effect on a second hay crop, R. P. WRIGHT (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 60–67*).—Tabulated details and discussion are given for experiments carried out in different seasons on 2 farms. Similar fertilizers were used in both cases, but comparison is limited by difference in seasons and in soils. The following general conclusions were reached:

All the manures employed, soluble as well as insoluble, had a decided influence upon the second year's crops. The application of muriate of potash exerted a marked effect, increasing the yield greatly the first year in both cases, and in the second year somewhat in one case and more than the first year in the other case. This fertilizer improved the clover and the author believes that the increase in the second year may be partly attributable to the effect of the clover in enriching the surface soil with nitrogen. On the plats to which larger dressings of mixed manures were applied the residual effects were clearly marked, though the increase was slight. On both farms mineral manures without nitrate of soda gave smaller crops in the first year, but in the second year showed a larger increase over the unmanured plat, this being due to the exhausting effect of the heavy crop of the first year upon the plats receiving nitrate of soda.

The application of salt alone gave disappointing results the first year, but a moderate increase over the unmanured plats in the second year.

Barnyard manure in moderate quantity with nitrate of soda proved more profitable than twice the amount of manure alone.

From these experiments and those with oats following turnips (p. 593) the author draws the following general conclusions:

"(1) Potassic manures, and all phosphatic manures, whether of a soluble or insoluble character, even when applied in small quantities, have a distinct effect in producing increase of crop in the second year as well as in the year of application.

"(2) The effect on a second crop as well as on a first confirms the conclusion derived from other experiments, that much more profitable returns are to be obtained from barnyard manure by applying it to crops in small rather than in large dressings, and by supplementing the small dressings with suitable artificial manures."

Experiments on the manuring of oats in 1895, R. P. WRIGHT (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 33–41*).—Coöperative experiments were made on 15 farms, 12 twentieth-acre plats differently fertilized being used in each case. Tables are given showing the kinds and amounts of fertilizers applied, location and soil of the farms, and yield per acre of oats and straw from each plat. The effects of the different combinations are discussed separately.

The following table shows the average yields of grain and straw and the increase over unmanured plats for each fertilizer.

Results of experiments with various fertilizers on oats.

Fertilizer.	Amount of fertilizer per acre.	Yield per acre.		Increase in yield per acre over unmanured plats.	
		Grain.	Straw.	Grain.	Straw.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Unmanured[1]	....	1,358	2,654	....	....
Nitrate of soda	112	1,473	3,000	115	346
Sulphate of ammonia	85	1,683	3,110	325	456
Superphosphate	224	1,657	2,859	299	205
Muriate of potash	112	1,622	2,883	264	229
Kainit	386	1,712	3,032	354	378
Nitrate of soda Muriate of potash	112 112	1,595	2,994	237	340
Nitrate of soda Superphosphate	112 224	1,763	3,159	405	505
Nitrate of soda Superphosphate Muriate of potash	112 224 112	1,716	3,141	358	487
Sulphate of ammonia Superphosphate	85 224	1,812	3,017	454	363
Sulphate of ammonia Superphosphate Muriate of potash	85 224 112	1,891	3,139	533	485
Barnyard manure	22,400	1,963	3,603	[2]632	[2]678

[1] Average of 2 plats on each farm.
[2] Compared with the average of the unmanured plats on the 7 farms only, on which barnyard manure was applied. This is 1,331 lbs. grain and 2,925 lbs. straw per acre.

The author gives the following conclusions:

"(1) Even in adverse seasons the produce of the oat crop can be largely increased by suitable applications of manures.

"(2) Even at the present low value of the oat crop, manures, judiciously applied to it, will give a very profitable return.

"(3) Not only can the total produce be largely increased by manuring, but the proportion of straw to grain can be considerably modified.

"(4) The date of ripening and of harvest can be either hastened or retarded by the employment of particular manures.

"(5) Potassic manures applied alone act effectively in a year of drought, but tend to retard ripening.

"(6) Superphosphate gives profitable returns, whether applied alone or in combination with other manures. It hastens ripening and increases the proportion of grain.

"(7) Nitrogenous manures, such as nitrate of soda and sulphate of ammonia, applied alone, retard ripening, but give large and profitable, though rather irregular, increases of crop.

"(8) These nitrogenous manures are more uniform and more reliable in their action when applied with a soluble phosphatic manure, and give, as a rule, larger, more profitable, and earlier crops when applied with superphosphate.

"The most successful combinations of manures employed in the experiments, taking into account the results for the two years 1894 and 1895, have been the following: (*a*) 112 lbs. nitrate of soda, 224 lbs. superphosphate; (*b*) 85 lbs. sulphate of ammonia, 224 lbs. superphosphate; (*c*) 85 lbs. sulphate of ammonia, 224 lbs. superphosphate, 112 lbs. muriate of potash."

Report on experiments on the manuring of turnips in 1895, R. P. WRIGHT (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 11–22*).—These experiments are in continuation of the series of 1893 and 1894 and the general conclusions are based upon the experience of the 3 years. In 1895 13 plats were used upon each of 34 farms in the southwestern and central portions of Scotland. Two plats of each series received no fertilizer and upon the others were applied superphosphate, basic slag, bone meal, and barnyard manure, alone and in different combinations with nitrate of soda, sulphate of ammonia, and sulphate of potash. Where comparison was made between one or two elements in different combinations the amounts of these elements on the plats were made equal. Tables are given showing the location and soil of the different farms, variety of turnips used, and yield of roots per acre for each plat. The effects of the different combinations are separately discussed and illustrated by tables.

The average results are given in the following table:

Effect of fertilizers upon turnips.

Fertilizer.	Amount of fertilizer per acre.	Roots per acre.		Tops per acre.[1]		Increase of roots over check plats.	
	Lbs.	*Tons.*	*Lbs.*	*Tons.*	*Lbs.*	*Tons*	*Lbs.*
Unmanured[2]	....	8	1,064	1	1,932	....	
Superphosphate	672	15	448	2	2,100	6	1,624
Basic slag	688	14	140	2	1,792	5	1,316
Bone meal	375	12	1,960	3	28	4	896
Basic slag Nitrate of soda	688 93¾	14	1,540	3	644	6	476
Superphosphate Nitrate of soda	672 112	15	1,708	3	1,120	7	644
Superphosphate Sulphate of ammonia	672 85	16	224	3	1,036	7	1,428
Superphosphate Nitrate of soda Sulphate of potash	672 112 112	17	1,344	3	1,400	9	280
Superphosphate Bone meal Nitrate of soda Sulphate of potash	672 448 112 112	17	2,100	3	1,800	9	1,036
Barnyard manure	44,800	18	756	3	2,044	9	1,932
Do. Superphosphate	22,400 448	18	588	3	1,204	9	1,764
Barnyard manure Superphosphate Nitrate of soda	22,400 448 112	19	672	4	336	10	1,828

[1] Average of 21 farms only. [2] Average of 2 plats on each farm.

The author draws the following conclusions from the experiments:

"(1) Good crops of turnips can be grown either with farmyard manure alone, or with artificial fertilizers alone.

"(2) A much better return can be obtained for barnyard manure by applying it to the crop, in a moderate dressing, along with suitable artificials, than by applying it in larger quantity alone.

"(3) When turnips are grown with artificial manures only, the manure used should contain all the 3 important ingredients—phosphoric acid, nitrogen, and potash.

"(4) The combination most successfully employed in these experiments was 672 lbs. superphosphate, 112 lbs. nitrate of soda, and 112 lbs. sulphate of potash.

"(5) The use of a complete manure containing the 3 important manurial ingredients gives more certain and more uniform results than the use of incomplete manures, and the complete manures render the crops less susceptible to unfavorable influences of weather or season.

"(6) The omission of potash causes, on the majority of farms in the west of Scotland, a considerable, and in many cases a large, reduction of crop, and a diminution of profits.

"(7) On a number of farms good crops can be grown with superphosphate alone, and the addition of nitrogenous and potassic manures does not on them produce a profitable return in the first crop.

"(8) Superphosphate is a more generally effective and reliable manure than basic slag when applied alone in spring to the turnip crop."

Report on the composition of turnips, J. HENDRICK (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 23–27*).—The soil on which these experiments were made was very uniform in quality and was in such poor condition that almost no crop was produced without manure. The plats were differently fertilized and planted with the same variety of turnips. Care was used to select representative samples and from 14 to 19 roots were analyzed from each plat. Tables are given showing the yields per acre of roots and tops upon each plat and the composition as affected by the different fertilizers. The principal data are shown below:

Effect of fertilizers upon the composition of turnips.

Fertilizer.	Amount of fertilizer per acre.	Average weight of roots.	Composition of roots.						
			Water.	Dry matter.	Protein.	Albuminoid nitrogen.	Sugar.	Fiber.	Ash.
	Lbs.	*Ozs.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Unmanured	....	1.5	82.38	17.62	3.71	0.24	7.33	2.34	1.12
Superphosphate	672	2.0	88.52	11.48	1.00	.12	6.12	1.18	.57
Basic slag	688	1.4	86.53	13.47	1.19	.15	7.11	1.45	.67
Do Nitrate of soda	688 94	1.4	86.17	13.83	1.13	.13	7.75	1.54	.62
Superphosphate Nitrate of soda	672 112	2.3	87.46	12.54	1.18	.10	7.38	1.24	.65
Superphosphate Bone meal Nitrate of soda Sulphate of potash	672 448 112 112	3.2	87.82	12.18	1.06	.09	7.07	1.30	.62
Barnyard manure	44,800	3.9	88.46	11.52	1.21	.09	6.37	1.23	.64
Do Superphosphate Nitrate of soda	22,400 448 112	2.9	87.13	12.87	1.16	.09	7.53	1.34	.65

The turnips from the unmanured plat were very small and contained much more than the normal amount of dry matter and of nitrogenous substances. The author believes that the excess of nitrogenous matters in these stunted turnips proves that the turnip is quite capable of obtaining a sufficient supply of nitrogen from a soil moderately supplied with this element and that the stunting is due to lack of ash

constituents. The total percentage of nitrogen does not appear to be increased by the application of nitrogenous manures, and where manures rich in this constituent are used the percentage of albuminoid nitrogen decreases so that even when such manures increase the weight of the crop they decrease its feeding quality by lowering the amount of albuminoid nitrogen contained in it. The presence of a moderate amount of soluble nitrogenous constituents, however, somewhat increases the percentage of sugar.

Residual value of manures applied to the turnip crop in 1893, as shown in the effect on an oat crop in 1894, R. P. WRIGHT (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 28–32*).—In 1893 turnips were grown on 12 twentieth-acre plats of clay loam differently fertilized, both roots and leaves removed. Oats were sown the following spring, one-half of each plat being left unmanured and the other half receiving nitrate of soda at the rate of 112 lbs. per acre. Tables are given showing statistics of fertilizers applied and crops of oats and hay produced on the unmanured half plats, and of oats on the half plats receiving nitrate of soda.

Each of the fertilizers showed a large residual value and every plat yielded a crop of oats much greater than that from the unmanured plat. Most of the fertilizer on 8 plats consisted of phosphates at the rate of 672 lbs. of superphosphate per acre, yet the residual effect of these moderate quantities not only fully recouped the land for the exhaustion caused by the removal from the fertilized plats of from 10 to 20 tons of turnips more than from the unmanured plat, but gave an increase of nearly 60 per cent in the oat crop. The soluble superphosphate produced a better subsequent effect than basic slag, as well as a better immediate effect. Bone meal did not give as large yield of turnips as superphosphate, but its slow-acting nitrogen produced a marked effect on the succeeding oat crop. The addition of a nitrogenous fertilizer to plats which had received only phosphates largely increased the yields, and the author concludes that "a comparison of all the plats where only artificial manures were applied in 1893 with plats to which barnyard manure was applied, shows that where turnips are grown with quickly available, and, perhaps, incomplete artificial manures alone, and where the whole crop is removed from the field, it is absolutely necessary to apply manures to the succeeding crops also if a full yield is desired."

The largest oat crops, both in grain and straw, were obtained from the barnyard manure plats, as were also the largest turnip crops in the preceding year; but 10 tons of barnyard manure with 336 lbs. of superphosphate and 112 lbs. of nitrate of soda produced a greater effect on the crops of both years than 20 tons of barnyard manure alone.

The addition of nitrate of soda to the half plats resulted in a profitable increase in every case.

Experiments with wheat, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 59, pp. 89–105*).—This is a continuation of work reported in Bulletin 47 of the station (E. S. R., 6, p. 538). Tabulated data are given for the experimental work noted under each subtitle.

Wheat grown continuously without manure (pp. 90, 91).—With an average on the experimental acre of 25.25 bu. for 13 crops harvested during 16 years the yield for 1896 was 24.85 bu. The authors state that the yield is falling off.

Early and late plowing (pp. 91, 92).—Land was plowed July 20 and September 3, and seeded September 18. The plats plowed in July averaged 23.66 bu., and those plowed in September, 19.74 bu.

Subsoiling vs. surface plowing (pp. 92–94).—The yield was larger where subsoiling was done 6 weeks before seeding than on plats plowed in the ordinary way. Plats subsoiled a year before seeding and which had borne a crop of peas in the interim gave no increase over the plowed plats.

Time of seeding wheat (pp. 94, 95).—The results are given for 4 plats seeded on 8 different dates from September 13 to November 1, inclusive, with intervals of 7 days. Seeding on September 20 gave the best average yield.

Seeding at different rates (pp. 95–97).—Seven series of 5 plats each were used. Seed was sown at the rate of from ½ to 2 bu. per acre, the unit of increase being 1 peck. The thin seeding tillered more than the thick seeding. The highest yield was given by the 2 bu. rate.

Grading seed wheat (pp. 98, 99).—Wheat from the thresher was separated into light and heavy grades, and these were compared with the ungraded seed. The light, common, and heavy seed weighed 44.75, 52.75, and 58 lbs. per bushel, respectively, and the corresponding yields were 34.89, 36.19, and 35.39 bu. The average of 4 years shows a slightly larger yield from the heavy wheat.

Effects of pasturing wheat (pp. 99, 100).—Ten out of 15 plats were grazed in the fall during 12 hours and in the spring during 10 hours by one cow on each plat. The pasturing apparently did no harm.

Wheat in rotation (pp. 100–102).—Twenty tons of manure seemed to be excessive for wheat, as the yields averaged smaller than with continuous cropping without manure.

Test of varieties (pp. 102–104).—On 47 twenty-fifth-acre plats 35 varieties were tested. The Turkey wheat is promising because it yields well and is hardy. On an average of several years the 6 varieties giving the largest yields are Andrews No. 4, Turkey, Valley, Tasmanian Red, Ramsey, and Currell.

Wheat experiments, 1895–'96, G. E. MORROW (*Oklahoma Sta. Bul. 20, pp. 1–9*).—Sixty-five varieties of wheat were tested. Hybrid Mediterranean, Nigger, and Missouri Blue Stem, among the bearded varieties, and Michigan Amber, Early Red Clawson, and Fultz, among the smooth,

gave the highest yields. The weight per bushel was light among all varieties.

In experiments with different quantities of seed per acre 3, 4, 5, 6, and 8 pecks were sown, with little difference in yield. The comparison of sowing in drills 6 and 8 in. apart was inconclusive.

Farm crops, C. O. FLAGG (*Rhode Island Sta. Rpt. 1895, pp. 183–188, figs. 2*).—This is a record of a number of trials on the station farm in which the growth of timothy and clover was very much benefited by heavy applications of lime. Clover failed where no lime had been applied.

On a 4-acre piece of sod 1,580 lbs. of a complete fertilizer and 2,300 lbs. of air-slacked lime were applied per acre. Corn was planted and the yield per acre was 62.43 bu. of shelled corn and 3,909.75 lbs. of stover.

Experiments in planting at different distances, J. RAULIN (*Ann. Sci. Agron., ser. 2, 1 (1896), No. 3, pp. 394–403, figs. 2*).—After discussing the tabulated results of experiments made in 1893, 1894, and 1895 with beets, potatoes, wheat, and barley, the author states that the best distance for planting varies for different kinds of plants; that there is an interval for each kind more advantageous than any other, and that in determining this it is necessary to bear in mind that diminishing the distance increases the total weight of the crop but lessens the weight of the product of the individual plant, and conversely, and that this takes place in different proportions for each kind of plant. The best distance, then, is the least distance beyond which increasing the distance does not improve the development of the plant, and so increase the value of the crop.

In general, the author concludes as follows: The total yield per acre increases as the distance between the hills diminishes, but this increase becomes less and less as the minimum limit is approached, and entirely disappears or even becomes negative below a certain limit. These variations depend much on the nature of the plant, on the development of its roots, and, in a certain degree, on the richness of the soil. Under given conditions the most favorable distance for each kind of plant is the one which returns the largest net profit per acre; and this depends on the total weight of the crop, the pecuniary value of the unit of weight (individual beet, tuber, kernel of grain, etc.), the weight of the seed sown, and the manual labor. The pecuniary value of the individual beet, tuber, etc., depends on the weight and richness in starch and gluten of the grain, on the proportion of starch for the potato, and of sugar for the beet.

Investigation of the 1896 crop of barley in Würtemburg, BEHREND (*Württ. Wochenbl. Landw., 1896, No. 51, pp. 747–752*).—Tabulated analyses with reference to moisture and protein content of 26 samples of barley grown under varied conditions of location, soil, and manuring; and discussion of results.

Sea Island cotton in peninsular Florida, G. E. MACY (*Florida Farmer and Fruit Grower, 8 (1896), No. 51, pp. 805, 806*).

A cotton bush, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, p. 649, pl. 1*).—Notes are given of *Kochia villosa*, a valuable salt bush for fodder, although inferior to Atriplex.

Manuring winter grains, L. VANDENBERCH (*Belg. Hort. et Agr., 8 (1896), No. 23, pp. 358, 359*).

Report on experiments on the manuring of hay conducted in the southwest of Scotland in the year 1895, R. P. WRIGHT (*Glasgow and West of Scotland Tech. College, Agl. Dept. Rpts. 1895, pp. 51–59*).

Lathyrus sylvestris, BONNET (*Jour. Agr. Prat., 61 (1897), I, No. 1, pp. 18, 19*).—An argument in favor of extending cultivation of this plant, with notes upon a field and feeding test.

Cultural experiments with different lupines, VON GRAEVENITZ (*Landw. Centbl. Posen, 24 (1896), No. 50, p. 281*).—Preliminary test on a small scale of *Lupinus cruckshanksii*, *L. mutabilis*, *L. albus*, and *L. nanus*. All seemed indifferent to marl, and *L. nanus* had a very short period of growth.

Effect of lime upon lupines (*Landw. Centbl. Posen, 24 (1896), No. 47, pp. 265, 266*),

The prickly pear as a forage plant, P. BOURDE, translated by J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 651–657*).—Notes are given upon the use of this plant and its fruit as food. The author believes its nutritive value, ability to withstand drought, and ease of cultivation make it worth further consideration, and that a valuable nonprickly variety may be developed.

Experiments of the German potato culture station in 1895 (*Sächs. landw. Ztschr., 1896, No. 51, pp. 617–623*).—Variety tests with special reference to starch content of 14 varieties.

Distance for planting potatoes, W. PAULSEN (*Deut. landw. Presse, 23 (1896), No. 103, pp. 916, 917*).

Report on experiments on seaweed as a manure for potatoes, J. HENDRICK (*Glasgow and West of Scotland Tech. College, Agl. Dept. Rpts. 1895, pp. 44–48*).

Sheep bushes and salt bushes (*Kew Bulletin; Agl. Jour. Cape Colony, 9 (1896), Nos. 25, pp. 638–641; 26, pp. 663–665*).

Trials of salt bush at Wagga Wagga, G. VALDER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 7, pp. 609–611, figs. 2*).—Notes are given on the culture of *Atriplex nummularia*, *A. halimoides*, *A. leptocarpa*, *A. semibaccata*, *Rhogodia hostata*, and *Kochia aphylla*.

Different methods of raising sugar beets, P. NEUMANN (*Fühling's landw. Ztg., 46 (1897), No. 1, pp. 16–19*).

What factors influence the sugar content of sugar beets (*Deut. landw. Presse, 24 (1897), No. 7, pp. 52, 53*).—Results of experimental work by B. Schulze in 1895 and 1896 are cited to show that climatic conditions, preparation and manuring of soil, and selection of seed influence sugar production in the order given.

Soil wastes in the cane field, E. M. SHELTON (*Queensland Dept. Agr. Bul. 11, 2d ser., pp. 19*).

Tobacco on the east coast of Florida, H. E. HARMAN (*Florida Farmer and Fruit Grower, 8 (1896), No. 51, p. 805*).

Tobacco culture, II, H. CURTIS (*Florida Farmer and Fruit Grower, 9 (1897), No. 4, pp. 53, 54, fig. 1*).

Chemical fertilizers for tobacco, S. PEACOCK (*Florida Farmer and Fruit Grower, 9 (1897), No. 4, p. 54*).

A bearded square head wheat, EDLER (*Landw. Wochenbl. Schles. Holst., 46 (1896), No. 40, pp. 580–582*).—This variety originated as a sport, and by selection and cultivation has been developed into a prolific yielder, possessing many desirable qualities.

Wire grass, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, p. 650, pl. 1*).—*Aristida stirpoides* is figured and described. The grass is said to furnish fodder while quite young, but it soon becomes too hard for stock to eat.

The root growth of plants in its physiological and cultural relations, IV, C. KRAUS (*Forsch. Geb. agr. Phys., 19 (1896), No. 1–2, pp. 80–129*).

Agricultural experiment work, N. A. COBB (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 663–689, figs. 49*).—The various influences which make plat testing inaccurate are discussed, and details are given of the row and pot systems, which the author considers preferable.

HORTICULTURE.

Trial of four-inch cast-iron and one and one-half inch wrought-iron pipe for the circulation of hot water in forcing-house heating, L. F. KINNEY and G. E. ADAMS (*Rhode Island Sta. Rpt. 1895, pp. 295–311, figs. 2*).—In a lean-to forcing house 11 by 30 ft., a double heating system was installed, 2 lines of 4-in. cast-iron pipe and 2 lines of $1\frac{1}{2}$-in. wrought-iron pipe being placed beneath benches extending round the walls of the house. The pipes were connected by means of common supply and return pipes with a heater in a separate room, and valves were so placed that either system could be used.

The large and small pipes were used on alternate days during a 10-day period in January, two 14-day periods in February, and an 18-day period in March, the valves being changed at noon, the water all drawn from the system and replaced with cold water, and a new fire made in the heater.

Tables are given showing the temperature inside and outside the house at 4 periods during each day, the relative humidity at 3 periods, the amount of coal consumed per day, the time required for each system to heat up and to cool off, and the temperature outside and within the pipes of the 2 systems.

The results are summed up as follows:

"With the same attention a heater maintained a higher temperature in a house when the water circulated in a system of large pipes than when it circulated in a similar system of small pipes, but that in doing this more coal was burned. The small pipes did not sustain the temperature during the last half of the night quite as well as the large ones. Between $2\frac{1}{2}$ and $2\frac{3}{4}$ lbs. of coal were burned for each degree of difference between the outside temperature and that in the house during the trial, and this varied but little when either system of the pipes was used. The atmosphere in the house was not quite as dry during the use of the small pipes as when the other system was in use."

Composition of melons, W. BERSCH (*Landw. Vers. Stat., 46 (1896), No. 6, pp. 473–476*).—Analyses were made of the whole fruit and the edible pulp of "sugar melons" (*Zuckermelonen*), Persican melons (*Persicaner melonen*), and watermelons, and the sugar was determined in the fresh substance and in the expressed juice. The sugar was found in every case to be dextrose.

The "sugar melons" averaged 3,184 gm. in weight, and the "Persican" melons 821 gm. Both were smooth and of a yellow color. The watermelons averaged 1,110 gm. in weight. It is stated that watermelons are grown extensively in Hungary, and in many districts supply nearly all the drink of the people during the hot season.

The analyses are as follows:

Analyses of melons.

	"Sugar" melons.		"Persican" melons.		Watermelons.	
	Edible portion.	Whole fruit.	Edible portion.	Whole fruit.	Edible portion.	Whole fruit.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Proportion of parts:						
Rind	....	37.10	....	42.39	....	35.19
Edible portion	....	46.52	....	49.03	....	60.37
Seeds, etc	....	16.38	....	8.58	....	4.44
	....	100.00	....	100.00	....	100.00
Composition of fresh fruit:						
Water	95.150	92.852	95.900	93.870	93.690	93.440
Protein	.649	1.592	.484	1.270	.614	.902
Fat	.082	.481	.076	.806	.067	.452
Dextrose	3.430	2.596	2.700	1.850	4.210	2.450
Nitrogen-free extract	.014	.927	.141	.275	1.070	1.426
Crude fiber	.331	1.064	.346	1.321	.123	1.011
Ash	.344	.488	.353	.608	.226	.319
	100.000	100.000	100.000	100.000	100.000	100.000
Composition of dry matter:						
Protein	13.394	22.250	11.800	20.710	9.731	13.740
Fat	1.694	6.728	1.854	13.140	1.062	6.890
Dextrose	70.632	36.320	65.850	30.180	66.730	37.360
Nitrogen-free extract	.289	12.970	3.439	4.485	16.946	21.740
Crude fiber	6.897	14.870	8.439	21.550	1.949	15.410
Ash	7.094	6.842	8.618	9.935	3.582	4.860
	100.000	100.000	100.000	100.000	100.000	100.000

The percentage of juice obtained by a pressure of 300 atmospheres was 70.09 from the "sugar melons," 72.03 from the "Persican" melons, and 87.60 from the watermelons, so that although the 3 kinds of melons contained nearly the same percentage of water, the watermelons were much the juiciest. They were also the sweetest, which may have been due to their being the freshest.

Investigations on the organic acids and the albuminoids are promised later.

Fertilizer experiments with pot plants, H. MÜLLER-THURGAU (*Jahresber. Vers. Sta. Wädensweil, 4, pp. 52-54; abs. in Bot. Centbl., 68 (1896), No. 9, pp. 298, 299*).—The author experimented with fertilizers upon various pot plants in cold frames. The mixtures used were: (1) Potassium nitrate, potassium phosphate, ammonium sulphate, and ammonium nitrate in the proportion of 30, 25, 10, and 35 parts of each, respectively, and (2) the same substances with the exception of the ammonium nitrate. It was found that the first mixture should be used when a luxuriant growth of the plant is desired, and the second when it is sought to cause the plant to bloom.

Pollination of plums, F. A. WAUGH (*Vermont Sta. Bul. 53, pp. 47–64, figs. 5, pl. 1*).—The author discusses briefly the general relations between cross fertilization and fruitfulness, as shown in the strawberry, pear, and grape, and considers that the failure of the plum to fruit under seemingly favorable conditions, the instances of success in practical plum culture by mixed planting and intergrafting of different varieties,

and observations upon plums by Bailey[1] and Heideman[2] indicate the necessity of cross pollination for this fruit also.

The author believes that each of the six modifications of the typical flower by which cross pollination is insured and self-fertilization prevented may exist in plum blossoms, particularly in varieties of the Americana group, but does not consider any variation of great significance except that of defective pistils. Figures are given showing typical pistils of 12 varieties of plum and comparisons of sound and defective pistils of *Prunus americana.* About 2,000 plum blossoms were examined and compared as to percentage of defective pistils and relative abundance of pollen production. The data are shown in the following table:

Percentage of defective pistils and abundance of pollen in plum blossoms.

Group.	Samples.	Blossoms.	Defective pistils.	Pollen bearing.			
				Scant.	Medium.	Abundant.	Very abundant
			Per ct.	*Samples.*	*Samples.*	*Samples.*	*Samples.*
Prunus americana, varieties	60	550	27.8	....	....	....	....
Prunus americana, type, wild	7	85	40.0	....	....	....	....
Prunus americana, nigra	6	53	5.7	....	....	....	....
Prunus americana, consolidated	73	688	27.6	7	23	20	10
Prunus chicasa	17	159	15.1	5	6	3	0
Prunus hortulana, varieties	18	171	24.6	2	11	3	2
Marianna	4	46	50.0	3	0	0	0
Prunus domestica, varieties	30	292	5.1	6	7	7	0
Prunus triflora, varieties	9	72	15.9	4	4	0	0

"From this it appears that about one-half of the pistils of the Marianna were defective; over one-fourth in *Prunus americana* (the common wild plum), only a little less in *Prunus hortulana* (the Wild Goose group), about one-sixth in the Chicasaws and Japanese plums, and only one-twentieth in the European varieties (*Prunus domestica*). The great discrepancy between the wild forms of the typical *Prunus americana* (mostly Western) and the variety *nigra* (mostly Eastern) is a point of considerable interest. . . .

"Different varieties vary greatly in the amount of pollen produced. This variation seems also to follow somewhat the specific parentage of the varieties. Thus plums of the Americana group are generally more abundant pollen bearers, though they seldom show serious deficiency. The Japanese plums are still weaker, while the Marianna is distinctly lacking in quantity and perhaps also in the quality of pollen produced."

In connection with the estimates of pollinating efficiency the author notes the facts that such estimates must be very rough, that there is a very decided difference in the quality of pollen, and that pistils of many varieties appear to have a pronounced selective ability for pollen; so that care must be exercised in drawing conclusions.

To gain some evidence as to the theory advanced by Goff[3] that the severity of Northern climates accounts for much of the defectiveness of pistils, a tabulation by sections is made of the varieties examined. The results do not sustain the theory as, except at one location which

[1] New York Cornell Bul. 38, p. 43 (E. S. R., 4, p. 164).

[2] Minnesota Hort. Soc. Rpt., 1895, p. 187.

[3] Wisconsin Sta. Rpt. 1894, p. 350.

had a uniformly high percentage of defective pistils, the percentage rather decreases than increases northward.

An experiment was made in protecting from cross fertilization the blossoms of 14 varieties, from 25 to 300 blossoms of each variety being covered by paper bags. Fruit did not set in 6 cases, and only ranged from 4 to 10 in number in the others, although the trees bore moderate or full crops.

Work in crossing was limited to 21 experiments with 11 varieties, 319 pollinations being made, and the results tabulated. "Beyond an indication that the typical Western forms of *Prunus americana* can be pollinated by the Eastern forms—var. *nigra*—these experiments show nothing."

The author believes that the limits of cross fertilization and the lines of affinity among plum varieties follow closely the botanical boundaries of the parent species, and he gives a conspectus showing the natural relationships of the various groups.

Strawberries, R. L. WATTS (*Tennessee Sta. Bul., Vol. IX, No. 2, pp. 13, pls. 6*).—Notes and tabulated data upon 54 varieties tested at the station, a compiled table of information from 24 growers in different parts of the State, and descriptions of 4 varieties of local origin which received favorable comment at a strawberry show. The reports from growers indicate that the most popular varieties in the State are: *Early*, Michel; *medium early*, Bubach and Crescent; *late*, Gandy; the most productive variety, Crescent or Haverland; and best all-purpose and shipping variety, Crescent.

Old asparagus roots, C. ANSCHICKS (*Amer. Gard., 18 (1897), No. 108, p. 40*).—Notes are given of the unsuccessful use of old roots in starting a new bed. The author states that good 1-year-old roots are the best to use.

Forced culture of beans, A. NYS (*Belg. Hort. et Agr., 8 (1896), No. 24, p. 372*).

Sulphate of ammonia vs. nitrate of soda for cabbages (*Farming World, 15 (1896), Jan. 1*).

Analyses of mushrooms (*New York State Sta. Rpt. 1894, p. 134*).—Analyses of several sorts of mushrooms grown at the station are given.

Forcing rhubarb, G. WYTHES (*Gard. Chron., ser. 3, 21 (1897), No. 526, p. 64*).—Gives varieties best adapted to forcing, and methods of culture.

Irrigation in the garden, W. H. JENKINS (*Amer. Gard., 18 (1897), No. 110, p. 71*).—A description is given of an irrigation plant and notes on liquid manure for the garden.

Variety test of apples, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 578–593*).—Descriptions and notes upon 21 varieties, and table showing yield in 1894, age of tree or graft, and season of fruiting of 155 varieties of apple and 16 of crab-apple.

The choke cherry in cultivation, F. W. CARD (*Garden and Forest, 10 (1897), No. 467, pp. 47, 48*).—Notes are given which seem to indicate that the choke cherry has been under cultivation for a considerable time in northern Pennsylvania.

The guava, G. S. ROWLEY (*Fruitman's Guide, 2 (1897), No. 52, p. 6*).—Notes are given on the culture and uses of this fruit.

Report on the olive tree and olive oil in Tuscany, CHAPMAN (*Dept. Agr. Queensland Bul. 10, n. ser., pp. 7*).—An account of the practices followed in Tuscany in the culture and preparation of olives and olive products for the market.

Classification of varieties of peaches, R. H. PRICE (*Garden and Forest, 10 (1897), No. 464, pp. 12, 13, fig. 1*).

Variety test of pears, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 608, 609*).—List of 130 varieties growing in the station orchard.

Pineapple culture, uses, and probabilities, G. I. RUSSELL (*Florida Farmer and Fruit Grower, 8 (1896), No. 51, p. 804*).

The fertilization of flowers in orchards and vineyards, especially in its relation to the production of fruit (*New York State Sta. Rpt. 1894, pp. 633–648, figs. 6*).—This paper, which was presented before the Ontario Fruit Growers' Association December 6, 1894, treats in a popular way of cross and close pollination. Extensive experiments with grapes are reported, the essentials of which have appeared in the Annual Report of the station for 1892, pp. 597–606 (E. S. R., 6, p. 46).

Removing and transplanting fruit and other trees (*Gard. Chron., ser. 3, 21 (1897), No. 524, pp. 20, 21*).

Close root pruning for trees, J. TROOP (*Garden and Forest, 10 (1897), No. 467. p. 46*).—Experiments were conducted with 4 trees each of dwarf and standard pears, cherries, prunes, peaches, and quinces. The roots were pruned until only about an inch remained. The results were considered very satisfactory. The season was very favorable, and it is thought possible that a dry season might give different results.

On the care of trees, J. PHILLIPE (*Belg. Hort. et Agr., 8 (1896), No. 24, pp. 374, 375, figs. 5*).—Describes implements for cleaning and pruning trees and vines.

Protecting trees against rodents (*Denver Field and Farm, No. 575, p. 12*).—Advises an application of axle grease to the tree or a wash made of lime, bluestone, sulphur, and water, to which glue has been added to make it adhesive, and also the use of wire netting.

The fruit garden, T. HOLLOWAY (*Amer. Gard., 18 (1897), No. 108, p. 36*).

Fruit growing in Oklahoma, H. E. GLAZIER (*Oklahoma Sta. Bul. 20, pp. 15–20*).—Popular directions are given for locating orchards, with special regard to the danger from late frosts; for selecting, planting, cultivating, and root pruning the trees; and for preventing injury by borers, mice, and rabbits.

Variety test of blackberries, dewberries, and raspberries, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 594–600, 610–616*).—Reprinted from Bulletin 81 of the station (E. S. R., 7, p. 33).

Notes on strawberries for 1894, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 617–632, pl. 1*).—A reprint of Bulletin 76 of the station (E. S. R., 6, p. 817).

The sweet edible service berry as a tree for cold climates and dry soils, A. SCHULTE (*Deut. landw. Presse, 23 (1896), No. 101, p. 901, fig. 1*).—Notes are given on *Sorbus aucuparia fructu dulci*.

Growing grapes from cuttings, C. C. NASH (*Amer. Gard., 18 (1897), No. 109, pp. 50, 51*).—Notes are given on the size and length of cuttings, number of buds, storing, planting, and cultivation.

Grape growing under glass, W. SCOTT (*Amer. Gard., 18 (1897), No. 109, pp. 49, 50*).—Notes are given for house construction, planting, cultivation, etc.

Will bees destroy grapes? J. TROOP (*Amer. Gard., 18 (1897), No. 110, p. 67*).—A colony of Italian bees was confined for 21 days under a Worden grapevine and received no food except what they got from the hive and from the grapes. At the end of that time careful examination failed to reveal any injury to the grapes.

Variety test of grapes, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 601–607*).—Notes upon 25 varieties.

Propagation of hardy bamboos (*Florists' Exchange, 9 (1897), No. 2, p. 25*).—Directions are given for propagation by seed, division, cuttings of base of culms and cuttings of the rhizomes.

Concerning carnations, A. HERRINGTON (*Amer. Gard., 18 (1897), No. 108, p. 35; 110, p. 66*).—Notes on cuttings, seedlings, and general treatment, together with the origin and history of the different races.

Propagation of carnations (*Amer. Gard., 18 (1897), No. 110, pp. 65, 66, fig. 1*).

Hardy palms in Florida, T. L. MEAD (*Florida Farmer and Fruit Grower, 9 (1897), No. 5, p. 67*).

Classification of sweet peas (*Florists' Exchange, 9 (1897), No. 1, p. 6, figs. 12*).—This classification is based on form of flower, especially of the standard, instead of on the color.

Some problems in experimental horticulture, W. M. MUNSON (*Amer. Gard., 18 (1897), No. 108, pp. 41, 42*).—Notes are given on plant breeding, acclimatization, domestication, etc.

Report of horticultural work, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 572–706*).—Brief outline of the work of the year, reprints of bulletins, and investigations noticed elsewhere.

The nursery book, L. H. BAILEY (*New York: The Macmillan Co., 1896, pp. XI, 365, figs. 152*).—This is a revised and enlarged edition of this work, first published in 1891. In the present edition it is deemed best to treat fully the prevalent assumption that grafting is necessarily a devitalizing process, and also to analyze the unclassified knowledge respecting the mutual influences of stock and scion and the respective peculiarities of root-grafted and bud-fruited trees.

In the nursery list, which has been considerably extended over that of the previous editions, the author has incorporated many notes and suggestions from correspondence, as well as the results of experiments of the past 5 years.

A chapter on pollination, which was included in the first edition, is omitted from the present one, since a similar one was incorporated in the author's work on "Plant Breeding." Both the "Nursery Book" and "Plant Breeding" are included in the "Garden Craft Series" of the publishers.

FORESTRY.

Timber pines of the Southern United States, C. MOHR (*U. S. Dept. Agr., Division of Forestry Bul. 13, pp. 1–130, pls. 20, figs. 12*).—A series of monographs is given relative to the more important timber pines of the South, viz, the long-leaf pine (*Pinus palustris*), the Cuban pine (*P. heterophylla*), the short-leaf pine (*P. echinata*), the loblolly pine (*P. tæda*), and the spruce pine (*P. glabra*).

The geographical distribution, characteristics of distribution in different regions, supply and production of products, nomenclature and classification, physical and mechanical characteristics, development, enemies, natural reproduction, and forest management are given for each species.

Of the different kinds enumerated the long-leaf pine is of the greatest economic importance. Unlike some of the other species, the locality where grown seems to have no effect on the quality of this pine. The rate of growth, reference to which has already been given (E. S. R., 7, p. 773), is slower than for the other species. This applies to growth in both height and diameter. The visible supply of long-leaf pine is given, and at the present rate of exploitation it will be exhausted in 40 to 50 years unless some system of forest management be adopted. The slow rate of growth and light requirements of the tree make rational management especially desirable, otherwise this valuable timber will soon be exhausted.

The enemies of this, as well as the other species, are enumerated and more or less fully described. Among the more important are forest fires, indiscriminate pasturing, insects, and fungus diseases. Suggestions are given for the prevention of these injuries.

In addition to the foregoing, an extended account is given of the turpentine and related industries and the effect of such industries upon the quality of the timber and the condition of the forests of long-leaf pine, that species probably furnishing the greatest quantity of these substances.

Associated with the long-leaf pine in its more southern range is the Cuban pine, the timber of which is said to be little if any inferior to that of the long-leaf species. This tree abounds in resin, and is also valuable on this account. The lumber of these two pines is said to be sawn and shipped rather indiscriminately, the two species being closely related, and to the casual observer identical. The rate of growth of the Cuban pine is much more rapid than that of its congener, resulting in a somewhat coarser structure of the wood, the durability of which is still to be ascertained.

The short-leaf pine has a more extended range than either of the other species mentioned. In commercial importance it is said to rank next to the long-leaf pine. This species is said to be less sensitive to a deficiency of light than some others, and on this account it becomes very aggressive whenever openings are made in forests. On account of its very rapid growth and the readiness with which it establishes itself, this species is destined to take an important position in systems of reforestation.

The loblolly pine produces timber a little inferior to the others, but on account of its rapid growth it will probably become an important factor in the future forests of the region where it abounds. There are several distinct grades of loblolly which are recognized by lumbermen under the names rosemary pine, swamp or slash pine, and old field pine, their relative value being in the order enumerated. Where strength and durability are not the prime requisites, loblolly pine ranks as of very great value.

The last species described is the spruce pine. It is much less common than the other species, and is confined to the subtropical portions of the United States, where it is frequently confused with the short-leaf pine. As it nowhere forms forests of any considerable extent, it is of little importance to the lumber industry. The timber is said to be rather poor in quality, light, soft, and easily worked, but is probably well adapted to certain uses.

An introductory chapter to the bulletin furnished by the Chief of the division, B. E. Fernow, consists mainly of a résumé of the contents of the various monographs. Especial attention is drawn to the necessity of rational methods of management of forests. Statistics of supply, consumption, rate of growth, etc., are plentifully supplied, which must prove valuable to any student of the subject.

Notes on the structure of the wood of the Southern pines, F. ROTH (*U. S. Dept. Agr., Division of Forestry Bul. 13, pp. 131–156, pls. 7, figs. 6*).—The author has made an elaborate study of the structure of the woods of the 5 principal timber pines of the South, viz: Long-leaf pine, Cuban pine, short-leaf pine, loblolly pine, and spruce pine. The investigations failed in establishing any macroscopic or microscopic features that could be used for specific determinations. The results of his investigations on the characteristics of the wood structure are given in detail.

Tree culture, C. B. WALDRON (*North Dakota Sta. Bul. 25, pp. 77–88, pls. 5*).—Directions are given for forest planting and the subsequent care of the trees. Compiled descriptions are given of the following trees, which are more or less adapted to the region indicated: White, soft, or silver maple (*Acer dasycarpum*), silver or white birch (*Betula papyracea*), cut leaf weeping birch (*B. alba laciniata pendula*), hackberry (*Celtis occidentalis*), white ash (*Fraxinus americana*), green ash (*F. viridis*), box elder (*Negundo aceriodes*), cottonwood (*Populus monilifera*), Russian poplar (*P. certinensis*), chokecherry (*Prunus virginica*), wild plum (*P. americana*), mountain ash (*Pyrus americana*), burr oak (*Quercus macrocarpa*), white or gray willow (*Salix alba*), golden Russian willow (*S. vitellina aurea*), basswood (*Tilia americana*), American or white elm (*Ulmus americana*), and cork or rock elm (*U. racemosa*).

Trials have been made at the station with red and white cedar, white and Norway spruce, balsam fir, and Scotch pine, and other evergreens, which do not warrant recommending them for general planting.

A table of hardiness of quite a number of forest trees and ornamental shrubs is reprinted.[1]

Notes on the growth of trees (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 660, 661*).—Notes are given of the growth of *Populus monilifera, P. pyramidalis,* and *Ulmus campestris.*

Influence of forests on the climate, M. HUFFEL (*Influence des forêts sur le climat. Besancon: Jacquin*).

The forest in relation to the farm, J. GIFFORD (*Forester, 2 (1896), No. 5, pp. 68–72*).

On the pruning of forest trees (*Bul. Soc. cent. Forst. Belgique, 3 (1896), Nos. 11, pp. 762–777, figs. 4; 12, pp. 837–852, figs. 26*).

Destruction of firs by drought (*Rev. Eaux et Forêts, ser. 2, 10 (1896), No. 23, pp. 557–560*).

On the care and culture of firs, DE GAIL (*Rev. Eaux et Forêts, ser. 2, 10 (1896), No. 23, pp. 529–538*).

The larch, its habitat and distribution, R. JUGOVIZ (*Oesterr. Forst. und Jagd. Ztg., 14 (1896), No. 48, pp. 377–380, figs. 10*).

The western larch (*Garden and Forest, 9 (1896), No. 459, pp. 491, 492, fig. 1*).—Notes are given on *Larix occidentalis,* a tree valuable on account of the superlative character of its timber, the readiness of seeding, and ability to withstand forest fires.

Nyssa sylvatica, J. T. ROTHROCK (*Forest Leaves, 6 (1897), No. 1, pp. 8, 9, pls. 2*).—An illustrated description is given of this tree.

The Corsican pine, D. CANNON (*Garden, 51 (1897), No. 1313, pp. 35, 36*).—Notes are given on *Pinus laricio,* said to be one of the most valuable of European pines.

[1] Minnesota Sta. Bul. 24 (E. S. R., 4, p. 654).

Height of the redwood, C. S. SARGENT (*Garden and Forest, 10 (1897), No. 467, p. 42*).—A brief account is given of trees of *Sequoia sempervirens* that were measured near Scott, California, last summer, one of which was 230 ft. to the first limbs and 340 ft. in total height.

Hardy coniferous trees, A. D. WEBSTER (*Hutchinson & Co. Reviewed in Gard. Chron., ser. 3, 21 (1897), No. 524, pp. 21, 22*).

Conifers at Kansas Agricultural College, F. C. SEARS (*Garden and Forest, 10 (1897), No. 465, p. 23*).—Notes are given on the growth and condition of red cedar, European larch, gingko, several firs, and arbor vitæs.

Patton's spruce (*Garden and Forest, 10 (1897), No. 463, pl. 1, figs. 2*).—Editorial notes are given of Patton's spruce (*Tsuga pattoniana*).

Remarks on the distinctive characters of Canadian spruces, G. LAWSON (*Canadian Rec. Sci., 7 (1896), No. 3, pp. 162–175*).

On the culture of osier willows (*Deut. landw. Presse, 23 (1896), Nos. 42, pp. 367, 368; 43, p. 375*).

Influence of raising the forest cover upon the growth of plants, G. HUFFEL (*Rev. Eaux et Forêts, ser. 2, 10 (1896), No. 23, pp. 546–548*).

Notes from the Santa Monica forestry station, J. H. BARBER (*Garden and Forest, 9 (1896), No. 457, p. 474*).—Notes are given of *Eucalyptus corymbosa*, *Parkinsonia aculeata*, and *Hakea laurina*.

Forestry in Pennsylvania (*Garden and Forest, 9 (1896), No. 462, pp. 521, 522*).

Forest conditions in the southern Sierras, F. M. GALLAHER (*Garden and Forest, 9 (1896), No. 460, pp. 503–505*).

Types of British woodland, A. C. FORBES (*Gard. Chron., ser. 3, 20 (1896), No. 522, p. 782*).—Describes beech woods and the methods of afforesting.

Rhine forests and their management, REBMANN (*Allg. Forst. und Jagd. Ztg., 72 (1896), pp. 381–386*).

The aboreal flora of maritime Belgium, L. BERGER (*Bul. Soc. cent. Forst. Belgique, 3 (1896), No. 12, p. 863*).

On the limits of elevation on forest culture in northern Scandinavia and vicinity, C. RABOT (*Rev. gén. Bot., 8 (1896), No. 94, pp. 385–417*).

The natural renovation of pine forests, B. BORGGREVE (*Ztschr. Forst. und Jagdw., 28 (1896), No. 11, pp. 670–679*).

Interesting foreign trees for planting in France, P. MOUILLEFERT (*Jour. Agr. Prat., 60 (1896), II, No. 46, pp. 717–721, figs. 4*).

Forests and forest management in Greece, G. N. COFINAS (*Rev. Eaux et Forêts, 35 (1896), No. 21, pp. 508–515*).

The exploitation of waste land in Holland (*Forester, 2 (1896), No. 5, pp. 72–76*).

Description of the royal forests of Prussia, M. G. HUFFEL (*Bul. Min. Agr. France, 5 (1896), No. 4, pp. 563–610*).

DISEASES OF PLANTS.

Bordeaux mixture, its use in the potato field, L. F. KINNEY (*Rhode Island Sta. Bul. 38, pp. 49–58, figs. 5*).—A report is given of the successful use of Bordeaux mixture in combating the late blight of potatoes. Seven applications were given the plants and the disease was almost wholly controlled, while all adjoining untreated fields suffered severely. The strength of mixture recommended is 1 lb. each of copper sulphate and lime and 4 to 8 gals. of water. In the experiment referred to above the first application was not made until after the disease was generally distributed throughout the field, yet the applications, being made frequently and thoroughly, were able to check its spread almost entirely and the crop was not appreciably affected.

Full directions are given for the preparation and application of the Bordeaux mixture.

Experiments for the prevention of potato rot, J. HENDRICK (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 49, 50*).—A report is given of 2 series of experiments to test the efficiency of Bordeaux mixture in preventing potato rot. Two formulas were used in making the fungicide. One, which is called the 2 per cent solution, was copper sulphate 4 lbs., lime 2 lbs., and water 20 gal.; the other, called the 1½ per cent solution, was copper sulphate 3 lbs., lime 1½ lbs., and water 20 gal. The plats of potatoes received 1 and 2 applications of each solution. On none of the plats was the disease abundant, although the variety of potatoes grown was one that was considered especially liable to disease.

In the first series there was a gain over the best check plat at the rate of 46 bu. per acre in favor of spraying twice with the 1½ per cent solution. In the second series the greatest total yield was from the check plat, although there was a decrease in the quantity of diseased potatoes in every sprayed plat.

The author appears to regard the results of these experiments as rather unfavorable to the use of Bordeaux mixture, but from the detailed account it would appear that the applications were not made with sufficient care and thoroughness, and, the amount of disease on the check plats being small, the difference between the treated and check plats would necessarily be slight.

On the prevention of smuts, L. FOSTER (*Montana Sta. Bul. 10, pp. 40–46*).—Notes are given on experiments conducted for the prevention of smut of wheat, barley, and oats.

The treatments tried for preventing wheat smut were hot water and copper sulphate solutions, the details of manipulation being given. The best results followed from grain receiving the hot-water treatment, although the copper sulphate solutions reduced, and in some cases prevented, all smut.

In the case of barley and oats the treatments were the same, but as no smut appeared in any of the barley plats the results can not be given.

The oats were treated with hot water at temperatures ranging from 126 to 150° and varying strengths of solutions of potassium sulphid, corrosive sublimate, zinc chlorid, zinc sulphate, potassium bicarbonate, and potassium permanganate. The results secured are tabulated, from which it appears that hot water was the most effective of the remedies tested, and immersion for 10 minutes at low temperatures better than less time at higher temperatures.

Club-root experiments, J. R. CAMPBELL (*Glasgow and West of Scotland Technical College, Agl. Dept. Rpts. 1895, pp. 9, 10*).—Experiments were conducted to test the liability of turnips and Swedes to infection by means of inoculation material sown over the drills prior to seeding. The tests showed that every one of the 21 varieties was more or less

affected, some so badly that the crop was practically worthless. It is demonstrated that leaving diseased roots on the ground or planting in too rapid rotation will serve to inoculate the subsequent crop.

It appeared from the foregoing experiment that some varieties were more susceptible to the disease than others, and another experiment with Achilles and Aberdeen Yellow turnips upon infected land showed that the Achilles was the more resistant, producing more than twice as many sound roots as the other variety.

Legal enactments for the restriction of plant diseases, E. F. SMITH (*U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 11, pp. 45*).—A compilation is given of the laws of the various States of the United States and provinces of Canada relating to the restriction of plant diseases.

Twelve States are shown to have some sort of law for the prevention of plant diseases, as follows: California, a general law; Connecticut, peach yellows; Delaware, peach yellows; Kentucky, black knot of plum and cherry; Maryland, peach yellows; Michigan, peach yellows and black knot of plum and cherry; New Jersey, for a cranberry disease, and of general application under special conditions; New York, peach yellows and black knot; Oregon, a general law; Pennsylvania, peach yellows; Virginia, peach yellows; Washington, a general law.

In addition to the foregoing the laws of Ontario and British Columbia are given.

Bacterial diseases of plants, V, E. F. SMITH (*Amer. Nat., 31 (1897), No. 361, pp. 34–41*).—A review is given of the present state of our knowledge of bacteriosis of hyacinths.

A critical review of the present state of our knowledge of bacterial diseases of plants, VI, E. F. SMITH (*Amer. Nat., 31 (1897), No. 362, pp. 123–138*).—The present paper deals with the gas-forming wet rot of the potato.

Smut and bunt, F. MADDOX (*Agl. Gaz. Tasmania, 4 (1896), No. 6, pp. 92–95*).

A new genus of Myxomycetes, E. ROZE (*Jour. Bot. France, 10 (1896), No. 24, pp. 424–426, fig. 1*).—A new genus with 2 species is described—*Amylotrogus discoideus* and *A. ramulosus*. The organisms are said to attack the starch grains of the potato, causing their destruction.

Macrosporium solani, F. FAUTREY (*Rev. Mycol., 19 (1897), No. 73, p. 9*).—The author notes the occurrence of this fungus in the potato fields of France and suggests the use of Bordeaux mixture for its prevention.

The diseases of potatoes (*Gard. Chron., ser. 3, 21 (1897), No. 523, pp. 12, 13*).—Popular notes are given of the more common potato diseases.

Fungus diseases of sugar cane, C. SPEGAZZINI (*Rev. Facultad. agron. y veterin. La Plata, 1896; abs. in Rev. Mycol., 19 (1897), No. 73, p. 19*).

Peach rosette, E. E. BOGUE (*Oklahoma Sta. Bul. 20, p. 21*).—The presence of peach rosette within the Territory is reported and the complete destruction of all diseased trees is recommended.

Peach yellows and black knot, A. D. SELBY (*Ohio Sta. Bul. 72, pp. 193–210, pl. 1, figs. 5*).—This bulletin, which was prepared with special reference to the requirements of a recent law relating to these diseases, gives in popular form a clear and concise statement of the present information relative to their cause, symptoms, and suggested treatment. A supplement is added in which the text of the law is given.

Nectria on currant canes, G. F. ATKINSON (*Garden and Forest, 10 (1897), No. 466, p. 34*).—Notes are given of an attack on currant canes due to *Nectria cinnabarina* and *Pleonectria berolinensis*.

Raspberry anthracnose (*New York State Sta. Rpt. 1894, pp. 684–686*).—Reprinted from Bulletin 81 of the station (E. S. R., 7, p. 38).

Carnation rust, H. WEBER (*Florists' Exchange, 9* (*1897*), *No. 5, p. 97*).—Notes are given on the probable cause and conditions favoring the development of this disease.

To abate carnation rust, F. DORNER (*Amer. Florist, 12* (*1897*), *No. 450, pp. 555, 556*).—Popular notes are given for the prevention of carnation rust.

Note on a pine cone deformed by Cæoma conigenum, N. PATOUILLARD (*Jour. Bot. France, 10* (*1896*), *No. 23, pp. 386–388, pl. 1*).—Descriptive notes are given of *Cæoma conigenum*, n. sp.

Bordeaux mixture for celery rust (*Amer. Gard., 18* (*1897*), *No. 110, p. 78*).—This mixture is said to discolor the celery, and ammoniacal copper carbonate, which is considered as efficient as Bordeaux mixture, is recommended.

Comparative experiments in preventing leaf diseases of grapes (*Deut. landw. Presse, 23* (*1896*), *No. 99, p. 883*).

Bordeaux mixture and molasses (*Agl. Gaz. N. S. Wales, 7* (*1896*), *No. 10, pp. 732, 733*).—Notes are given of the successful use of Bordeaux mixture to which molasses was added. It adhered better and did not clog the sprayer.

Winter treatment of fungi and insects (*Pacific Tree and Vine, 1896, Dec. 26, p. 149*).—Notes are given for winter treatment of fruit trees with various washes.

Spraying pear and apple orchards in 1894 (*New York State Sta. Rpt. 1894, pp. 649–683, figs. 7*).—Reprint of Bulletin 84 of the station (E. S. R., 7, p. 139).

Observations on the application of fungicides and insecticides (*New York State Sta. Rpt. 1894, pp. 687–706, figs 12*).—Reprint of Bulletin 74 of the station (E. S. R., 6, p. 739).

The cucumber and tomato eelworm (*Internat. Jour. Micros. and Nat. Sci., ser. 3, 7* (*1897*), *No. 33, pp. 52–56, pl. 1*).—Notes are given of *Heterodera radicicola* with remedies.

Report of horticultural work, S. A. BEACH and W. PADDOCK (*New York State Sta. Rpt. 1894, pp. 573, 574*).—A brief report is given on the principal lines of work conducted during the year. Among those relating to plant diseases observations were continued on pear leaf blight, apple and pear scab, and raspberry anthracnose, and comparisons of spraying apparatus.

ENTOMOLOGY.

The laying of a queen (*Gard. Chron., 21, No. 5252, p. 41*).—A colony of bees was watched from January to December, 1891. On January 1 there appeared to be about 10,000 bees in the hive, at the end of the season about 20,000. For the whole time there were about 890 eggs laid per day, or for the season of the honey flow (March 3 to August 3) the number of eggs per day averaged 1,760. The highest daily average was (March 18 to April 10) 2,600.

The colony did not swarm, and over 300,000 bees were hatched and passed away. The colony produced 180 pounds of honey.

The army worm in New Hampshire, C. M. WEED (*New Hampshire Sta. Bul. 39, pp. 62–75, figs. 10*).—In this bulletin the author gives a summary of our knowledge of this insect (*Leucania unipuncta*), together with the results of a study of an outbreak in New Hampshire in 1896. Serious injury was done in July, especially in barley fields, and again in September in fields of Hungarian grass. The moths seemed sometimes attracted by buildings and early in August they

were trapped by thousands in a projecting porch. A thousand were killed, placed in a heap, and photographed.

Among the natural enemies the author notes especially the robin, blackbird, bobolink, meadow lark, the black ground beetle, the tachinid and ichneumon flies, and ground spiders. To the action of these, he thinks, is due the strange disappearance of this vexatious pest frequently noted.

As remedial measures he recommends (1) spraying with kerosene emulsion, (2) trapping in ditches and trenches, (3) fencing out, (4) poisoning with Paris green, the powder being applied with a duster or insect-powder gun, (5) drawing the rope, and (6) burning over grass lands.

Notes on the recent invasion of the army worm, V. H. Lowe, (*New York State Sta. Bul. 104, n. ser., pp. 121–129, pls. 2, figs. 2*).—Notes are given on the recent serious invasion of the army worm (*Leucania unipuncta*), it having been reported from 28 counties, representing the more important agricultural sections of the State. The insect is popularly described and its life history given, together with notes on the injury which it causes and on its natural enemies.

The author suggests for checking the army worm the plowing of deep furrows around infested fields or in front of the advancing insects. In pasture fields where the surface of the ground is comparatively even and the soil is firm, the caterpillars may be crushed by a heavy roller. Spraying of crops with a strong mixture of Paris green and water may also be resorted to. In this case it is not necessary to spray more than a strip about a rod wide in advance of the caterpillars.

The palmetto scale, T. D. A. Cockerell (*Garden and Forest, 10 (1897), No. 464, p. 19*).—A letter states that the palmetto scale has been observed on the Pacific Coast on the leaves of palms from Mexico. The palms were thought to have come from Mazatlan, where they were growing wild, about 75 to 100 miles inland. These Mexican specimens represent a variety (*Mexicana*) distinguished from the Florida form by the female (under the scale) being orange yellow, and the ventral grouped glands, numbering in caudolaterals, 14 to 17; in mediolaterals, 11 to 15; and in cephalolaterals, 7 to 10. For horticultural purposes the two forms may be treated as one.

Dactylopius or mealy bugs, T. D. A. Cockerell (*Sci. Gos., n. ser., 3 (1897), No. 32, pp. 199–201, fig. 1*).—A short, semipopular account of the mealy bugs, with remarks on their study in Europe and elsewhere, and upon books for the student of coccids. Descriptions are given of a new species, *Dactylopius lichensioides*, found at Fort Collins, Colorado, on the flowering stem of *Artemisia frigida*, September 25, 1896, by C. P. Gillette, and of one described originally by Maskell and Newstead in 1893, from specimens found in Demerara and observed by G. C. Davis on palms in a hothouse in Michigan. A very brief descriptive list is also given of 24 species of Dactylopius thus far known to occur

in Europe, either native or in hothouses. The figure represents the new species in a sac on a twig of artemisia.

Biology of the cockchafer (*Rev. Sci., ser. 4, 7 (1897), No. 1, pp. 27, 28*).—Some observations on the life history of *Melolontha vulgaris*. Older authors are criticised and the eggs, larva, nymph, and imago described anew. The main point made is that the adult insect lives from 45 to 62 days, much longer than has previously been described. A few observations are also made on the destruction of white grubs.

Insects injurious to stored grain and cereal products, A. L. QUAINTANCE (*Florida Sta. Bul. 36, pp. 358–385, figs. 16*).—In this are given mostly compiled short popular accounts and descriptions of the Angoumois grain moth (*Gelechia cerealella*), the meal snout moth (*Pyralis farinalis*), the Mediterranean flour moth (*Ephestia kuehniella*), the Indian meal moth (*Plodia interpunctella*), the granary weevil (*Calandra granaria*), the rice weevil (*C. oryza*), the bean weevil (*Bruchus obtectus*), the Chinese cowpea weevil (*B. chinensis*), the four spotted bean weevil (*B. quadrimaculatus*), the pea weevil (*B. pisi*), the slender horned flour beetle (*Echocerus maxillosus*), the confused flour beetle (*Tribolium confusum*), the rust red flour beetle (*T. ferrugineum*), the red grain beetle (*Carthartus gemellatus*), the corn silvanus (*Silvanus surinamensis*), the grain eating brachytarsus (*Brachytarsus alternatus*), and the catorama flour beetle (*Catorama punctulata*).

Of these the rust red flour beetle and the corn silvanus, besides their usual destructiveness to cereals, etc., are mentioned as serious museum pests. The confused flour beetle is said not to be present in great numbers, but may become so, while the meal snout moth and the Mediterranean flour moth, which are at present not known to occur in Florida at all, may be expected at any time.

The grain eating brachytarsus is reported for the first time as injurious to stored grain; the larvæ have previously been supposed to be parasitic on scale insects and coccids. But it has been found feeding in larval and adult condition in stored cowpeas and English peas, and doing serious damage.

The most injurious of this list are the Angoumois grain moth and the rice weevil.

Fully 20 per cent of all corn stored in granaries, the author estimates, is destroyed by insects, which signifies an annual loss to the State of $492,598.15.

As a remedy the use of carbon bisulphid is recommended.

Some Mexican and Japanese injurious insects liable to be introduced into the United States (*U. S. Dept. Agr., Division of Entomology Bul. 4, tech. ser., pp. 56, figs. 6*).—This bulletin consists of a series of articles, 3 of which relate to Mexican insects, 1 specifically to Japanese insects, and 2 to insects which may enter this country mainly from Japan, but also from other Pacific ports, principally Hawaii and Australasia.

A report is given by C. H. T. Townsend of a trip in Mexico to investigate the insects of economic importance. The author visited various regions from which produce is shipped and investigated the injurious insects which are liable to be introduced into this country. Lists of species are given, together with the plants which they frequent and notes on their economic importance. Attention is called to several species of scale insects which are especially destructive and, in the author's opinion, liable to be introduced into this country. It is suggested that all plants, fruits, stored grain, roots, and vegetable products of any description be inspected before crossing the border into the United States.

The insects affecting stored cereal and other products in Mexico are listed by F. H. Chittenden and notes given on their economic importance.

Notes and descriptions of new Coccidæ collected in Mexico by C. H. T. Townsend are given by T. D. A. Cockerell, in which 12 species and varieties are described.

A list of scale insects found upon plants entering the port of San Francisco is given by a quarantine officer of the State Board of Horticulture of California, A. Craw, including the name of the species, country from whence it came, and the trees and plants frequented by it.

Descriptions of some Coccidæ found by A. Craw in his quarantine work at San Francisco are given by T. D. A. Cockerell, in which 5 new species are described.

Descriptions and notes of some new species of Japanese Coccidæ are given by T. D. A. Cockerell, in which new genera and species are described.

Report of entomologist, I, T. D. A. COCKERELL (*New Mexico Sta. Bul. 19, pp. 99–118, fig. 1*).—The author gives an account of the localities visited during the past year and the insects noted at each place.

Special attention is called to Howard's plum scale (*Aspidiotus howardi*), a description of which is given and characters drawn up whereby it may be distinguished from a nearly related species, *A. ancylus*.

Notes are given on the San José scale and its distribution, with directions for preventing its spread, and also notes on the codling moth (*Carpocapsa pomonella*), grapevine leaf hoppers (*Typhlocyba coloradensis* and *Dicraneura cockerellii*), wild cherry webworm (*Clisiocampa fragilis*), sugar beet worm (*Loxostege sticticalis*), tomato worm (*Heliothis armigera*), apple twig borer (*Amphicerus bicaudatus*), and small case bearers (*Coleophora fletcherella* and *C. malivorella*).

Annual report of the zoölogist for 1896, C. WARBURTON (*Jour. Roy. Agr. Soc. England, ser. 3, 7 (1896), pp. 761–772, figs. 3*).—A report containing more or less original descriptions and notes on the cutworms (*Agrostis segetum* and *A. exclamationis*), the apple blossom weevil (*Anthonomus pomorum*), a leaf-eating weevil (*Phyllobius*), the apple aphis or green fly, the pear midge (*Diplosis pyrivora*), the seaside

weevil or traveling gang (*Philopedon* (*Cucorrhinus*) *germinatus*), a beetle infesting malt sacks (*Tribolium ferrugineum*), the death's head moth (*Acherontia atropos*), the swift moth (*Hepialus lupulinus*), the cockroach (*Phyllodromia germanica*), the asparagus beetle (*Crioceris asparagi*), tortrix, wireworm, the sheep bot fly (*Œstrus ovis*), the frit fly (*Anthomyia radicum*), the pear sawfly (*Eriocampa limacina*), and the garden chafer (*E. horticola*).

As a remedy for cutworms, hand picking, harrowing the ground frequently, dressing with manure just before a rain to push the plants through the attack, and a thorough stirring of the land after harvesting the crops, are recommended. For apple pests he recommends banding the trees in the fall, cleaning the trunks in winter, spraying with an arsenic preparation in spring, and attending to the ground beneath the trees. For the pear midge he advocates extermination, even at the expense of an entire crop, by stripping off the fruit before the insect has left it, and such treatment of the ground in winter as will destroy the pupæ.

The seaside weevil, hitherto not recorded as an agricultural pest, is mentioned as found affecting crops. As remedies are recommended the destruction of the natural food plant, the hound's tongue (*Cynoglossum officinale*), from the neighborhood of the fields likely to be affected, or, since the insect is wingless, fencing with tarred boards, also shaking off into bags, washing with quassia infusion, or the introduction of an army of chickens.

A decoction of the leaves of foxglove is noted as having been successfully employed against the asparagus beetle (*Crioceris asparagi*). Further, it is noted that in a grove of oaks, badly infected with tortrix, the trees that escaped proved to be *Quercus robur pedunculata*.

An emulsion for chicken lice (*Indiana Farmer, 32 (1897), No. 4, p. 7*).—One and a half gallons of kerosene are soaked through 2½ lbs. of pyrethrum and to 1 gal. of the resulting extract 1 lb. of soap is added, and the whole churned until emulsified. Dilute this with 3 parts of water before using.

Practical entomology, A. D. HOPKINS and W. E. RUMSEY (*West Virginia Sta. Bul. 44, pp. 247–325*).—This bulletin, which describes the insects injurious to farm and garden crops, the character of the injury, the insect causing it, and the remedy, is designed especially for the practical farmer and gardener desiring a work of reference in which is plainly stated information on some of the more important facts with reference to insects injurious to cultivated plants. It is also intended to be of service to the young student of economic entomology who desires a simple guide to the study of common insects and the nature of their injuries.

The insects and injuries are classified according to the plant and part of the plant which they frequent, and the descriptions are clearly drawn without the use of any unnecessary scientific terms, the technical names being given in footnotes.

A chapter is given on remedies, in which numerous formulas are included, with directions for preparation and use.

To keep out moths, G. W. WILLIAMS (*St. Louis Jour. Agr., 37 (1897), No. 3, pp. 22, 23*).—This describes a screen room for working with comb frames.

Some of the needs of bee keepers of southern California, C. C. ALDRICH (*Pacific Rural Press, 53 (1897), No. 3, p. 38*).—Advises the migratory system for uncertain climatic conditions.

On the host animals of the Nycteribidæ: Strebla and Megistopoda, V. VON RÖDER (*Ent. Nachr., 22 (1896), No. 21, pp. 321–324*).

The tent caterpillar, C. M. WEED (*New Hampshire Sta. Bul. 38, pp. 46–59, figs. 14*).—A popular bulletin in which the history and life history of the tent caterpillar (*Clisiocampa americana*), its diseases and other natural enemies, and methods for its destruction by burning and spraying are given.

The larger cornstalk borer, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circ. 16, pp. 3, figs. 3*).—The author gives the description, distribution, natural history, habits, and amount of damage caused by the larger cornstalk borer (*Diatræa saccharalis*), and suggests remedies for preventing its attacks.

The peach tree borer, C. L. MARLATT (*U. S. Dept. Agr., Division of Entomology Circ. 17, pp. 4, fig. 1*).—Description, natural history, and habits of the peach tree borer (*Sannina exitiosa*) are given, with suggestions for its prevention.

Borers (*Florida Agr., 24 (1897), No. 3, p. 35*).—Recommends removing borers with wire and coating wound with rubber paint or pine tar. Cautions against using carbolic acid or "dendrolene." Lime and sulphur are better. Caustic potash is harmful.

Melon louse, E. E. BOGUE (*Oklahoma Sta. Bul. 20, pp. 22, 23*).—Brief descriptive notes are given on the melon louse (*Aphis cucumeris*), and directions are given for its destruction either by means of kerosene emulsion or by the use of fumes of carbon bisulphid.

A Lecanium scale infesting plum trees in western New York, V. H. LOWE (*New York State Sta. Rpt. 1894, pp. 732–734*).—A brief description of 8 experiments in the application of kerosene emulsion of different strengths for the repression of this insect. The cost of the different applications is given, but the author's studies were not carried sufficiently far for a detailed account of the life history of this insect, nor for a definite statement as to the percentage of scales killed by the treatment employed.

The San José scale, F. M. WEBSTER (*Ohio Sta. Bul. 72, pp. 211–217, figs. 4*).—A brief illustrated description is given of the San José scale (*Aspidiotus perniciosus*), with notes on its life history, remedies, and a list of trees and other plants known to be infested by it. The act of the State legislature relating to the San José scale is quoted.

Oyster shell and San José scale (*Farmers' Review, 28 (1897), No. 1, p. 5*).—Gives a popular method for distinguishing the two.

The woolly aphis (*Garden, 6 (1897), No. 1312, Jan., pp. 20, 21*).—The ravages of the woolly aphis (*Schizoneura lanigera*) have decidedly increased in England within the last few years, and seriously affect the orchard and apple plantations wherever trees have been neglected.

Insects affecting late cabbage, notes on the stalk borer, and insecticides, F. A. SIRRINE (*New York State Sta. Rpt. 1894, pp. 737–765, pls. 2*).—This is a reprint of Bulletin 83 of the station (E. S. R., 7, p. 144).

Some insects injurious to squash, melon, and cucumber vines, and the asparagus beetle, V. H. LOWE (*New York State Sta. Rpt. 1894, pp. 711–731, pls. 4, figs. 3*).—This is a reprint of Bulletin 75 of the station (E. S. R., 6, p. 833).

An acarine parasite of the vine, J. PERRAUD (*Compt. rend. Soc. Biol. Paris, 1896, Dec. 26*).—Relates to *Giardius vitis*.

Predaceous and parasitic enemies of aphides (including a study of Hyperparasites), H. C. A. VINE (*Internat. Jour. Micros. and Nat. Sci., ser. 3, 6 (1896), No. 32, pp. 369*).

System of the North American Lepidoptera, A. R. GROTE (*Hildesheim Mitt. Römer-Museum, 1896, Nov., pp. 4*).

Systematic revision of the European species of the family Culicidæ, E. FICALBI (*Bul. Soc. Ent. Ital., 27 (1895), p. 38; 28 (1896), pp. 108-196, pl. 1*).—In Part I the systematic arrangement of the European species is considered; in Part II the anatomy is treated at length; and in Part III, which is not completed, the general relationships of the Culicidæ and other Diptera are considered.

Review of the known Palearctic species of the Coleopterous genus Brachyleptus, E. REITTER (*Ent. Nachr., 22 (1896), No. 19, pp. 293-296*).

The parasitic hymenopterous fauna of Ottawa—Proctotrypidæ, W. H. HARRINGTON (*Ottawa Naturalist, 10 (1896), No. 9, pp. 174-178*).

Contribution to the lepidopterous fauna of the Canary Islands, H. REBEL (*Ann. k. k. Nat. Hist. Hofmuseums, 11 (1896), No. 2, pp. 102-149, pl. 1*).

The Hemiptera Heteroptera of the British Islands, VIII, J. EDWARDS (*London: 1896, pp. 12, 225-271, pls. 2*).

Bibliography of the more important contributions to American economic entomology, V, S. HENSHAW (*U. S. Dept. Agr., Division of Entomology, pp. 179*).—This is the concluding part of the bibliography of the more important writings of Government and State entomologists and other contributors to literature on American economic entomology, and includes the authors from L to Z. Brief annotations are given after each reference, indicating the scope of the publication referred to.

FOODS—ANIMAL PRODUCTION.

Dietary studies at Purdue University in 1895, W. E. STONE; comments by W. O. ATWATER and C. D. WOODS (*U. S. Dept. Agr., Office of Experiment Stations Bul. 32, pp. 28*).—Two dietary studies, one of a teacher's family and one of a mechanic's family in Indiana, were made in the customary manner (E. S. R., 7, p. 148). A number of Indiana foods were analyzed. The composition of other foods was computed from standard tables. Tables are given showing the amount of food purchased, wasted, and eaten, its cost, composition, and fuel value. The results of these studies are briefly summed up in the following table:

Results of dietary studies—food eaten per man per day.

	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
	Cents.	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Teacher's family	18	106	102	340	2,780
Mechanic's family	26	90	134	408	3,285

In the comments on these dietaries the results are compared with results of similar studies made in other localities in the United States and with the generally accepted dietary standards.

"[These results] show very plainly that the more costly dietary is not necessarily the more attractive or nutritious. It could not be said that the tinner's dietary,

which cost 26 cts. per day, was in any way preferable to that of the teacher's family, which cost 18 cts. per day. On the contrary, the latter was the more rational and substantial. . . .

"The dietary of the teacher's family constitutes an exceptionally good example of intelligent and economical management, securing at the same time excellent living. The tinner's dietary was in no way an exception, but is probably quite typical of the manner of living of the great majority of wage earners of the better class."

Composition and digestibility of linseed meal, H. SNYDER (*Minnesota Sta. Bul. 47, pp. 20–30, fig. 1*).—Two digestion experiments were made with 2 pigs weighing about 170 lbs. each. The ration consisted of 1½ lbs. linseed meal (old process) and 9 lbs. of raw potatoes per day. The digestibility of the potatoes had been determined in a previous experiment. The linseed meal was mixed with a little water, and the sliced potatoes added. The pigs did not relish such large quantities of linseed meal, and in order to make them eat the ration 4 oz. of shorts per day was added. The average coëfficients of digestibility were as follows: Total dry matter 77.5 per cent, ash 10, crude protein 86, fat 80, crude fiber 12, and nitrogen-free extract 85. Linseed meal is found to be slightly less digestible than corn meal and as digestible as wheat, barley, shorts, or bran.

Linseed meal and the old and new process of manufacture are discussed at some length. The value of the manure produced by the animals in the above experiment is noticed elsewhere (p. 575).

Comparative feeding value of linseed meal (pp. 25–30).—In a table the author states the digestible nutrients and heat units which can be purchased for $1 when grain and milled products are at various prices. The feeding value of linseed meal and other feeds is briefly discussed as well as the effects of linseed meal upon the quality of butter and its use in a ration for dairy cows.

The food value of corn scorched by hot winds, G. L. HOLTER (*Oklahoma Sta. Bul. 20, pp. 9–15*).—The corn was from a field which suffered from hot winds. The blades curled up and the corn ceased to grow. A short time afterwards there were abundant rains, but the corn never recovered. The yield of ears of scorched corn was about one-tenth, and the fodder produced not more than two-thirds of an average crop.

"The corn under consideration was not so badly scorched that it was made unpalatable. It had the appearance of ripened corn ready to be cut. The fodder was fully as succulent as corn fodder is when it becomes fully matured, and certainly was an improvement, as far as appearances go, over fodder that has been badly frosted."

In the following table analyses are given of the water-free substance of the whole plant without ears, the blades and husks, the ears, and the stalks of corn scorched by hot winds:

Composition of corn scorched by hot winds in the summer of 1894.

	Water-free substance.				
	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Whole plant, without ears	9.62	12.50	36.29	39.36	2.23
Blades and husks	7.57	10.23	28.75	50.29	3.16
Whole ears	2.23	14.83	5.88	72.82	4.24
Stalks only	7.22	8.94	36.02	45.36	2.46

For the sake of comparison, the author gives analyses of cornstalks, corn stover, and whole ears from an average crop raised under normal conditions. The calculated dry matter per ton and digestible dry matter per ton in the whole plant of scorched corn, the blades and husks, the whole ears, and the stalks are also given.

The author concludes that scorched corn has a feeding value, and should always be utilized.

On the influence of the addition of fat and of starch to the ration upon the assimilation of nutrients and upon the metabolism and gain of nitrogen in the animal body, A. WICKE and H. WEISKE (*Ztschr. physiol. Chem., 22 (1896), No. 2, pp. 136–152*).—This is a continuation of work previously reported (E. S. R., 8, p. 321). The author tested the influence of the addition of fat and of starch to a ration containing an abundance of protein and fat. The experiment, which was divided into 3 periods, was made with the same sheep as the previous series. The sheep weighed at the beginning 52 and 41 kg., respectively. During the whole experiment sheep No. 1 was fed a basal ration of 800 gm. of meadow hay and 200 gm. of flaxseed (from which part of the oil had been removed), and sheep No. 2, 650 gm. of meadow hay and 200 gm. of flaxseed. The experiment proper was preceded by a preliminary test of 8 days.

During the first period, which lasted 8 days, the sheep were fed the basal ration only. In the second period, which lasted 9 days, sheep No. 1 was fed 146.4 gm. of starch per day in addition, and sheep No. 2, 50 gm. of olive oil, an isodynamic quantity of fat. During the third period, which lasted 9 days, sheep No. 1 received 60 gm. of olive oil per day in addition to the basal ration. It was the intention to feed sheep No. 2 an isodynamic quantity of starch during this period, but the authors were not able to complete the experiment. The water drunk was recorded each day.

The food, urine, and feces were analyzed. The results of the experiment are expressed in detail in tabular form. The coëfficients of

digestibility of the rations in the different periods are given in the following table:

Coëfficients of digestibility in experiments with sheep.

	Animal.	Dry matter.	Organic substance.	Protein.	Fat.	Crude fiber.	Nitrogen-free extract.	Ash.
		Per cent.	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay and flaxseed ..	No. 1....	64.18	67.49	73.15	76.85	62.67	65.50	26.15
Do	No. 2....	64.07	67.44	71.47	81.46	62.13	64.79	24.60
Hay, flaxseed, and starch	No. 1....	67.28	70.27	69.19	78.08	60.08	72.39	26.55
Hay, flaxseed, and olive oil..........	No. 1....	63.44	66.53	71.58	87.78	62.10	58.77	25.10
Do	No. 2....	64.67	67.76	72.02	86.45	65.66	59.81	25.63

The daily nitrogen balance for each period is shown in the following table:

Nitrogen balance in experiments with sheep.

	Animal.	Nitrogen in—			
		Food.	Urine.	Feces.	Gain.
		Grams.	*Grams.*	*Grams.*	*Grams.*
Hay and flaxseed	No. 1...	22.04	15.16	5.92	0.96
Do	No. 2...	19.39	13.11	5.53	0.75
Hay, flaxseed, and starch	No. 1...	22.04	13.59	6.81	1.64
Hay, flaxseed, and oil	No. 1...	22.04	14.75	6.27	1.02
Do	No. 2...	19.39	12.58	5.43	1.38

The author's conclusions may be briefly summarized as follows:

The addition of starch to the ration diminished the digestibility of protein and crude fiber. The addition of fat to the ration exercised no influence on the digestibility and assimilation of protein and crude fiber, but diminished the assimilation of fat. The addition of starch and fat to the ration did not cause as great a gain of nitrogen as when added to a ration containing little fat and protein. Starch was a better protector of protein than isodynamic quantities of fat.

The experiment is discussed at length in its relation to the previous work of the authors and of others.

On the influence of the addition of increasing quantities of fat to the ration upon the metabolism and gain of nitrogen in the animal body, A. WICKE and H. WEISKE (*Ztschr. physiol. Chem.*, *22 (1896), No. 3, pp. 265–277*).—This experiment is a continuation of the work reported above and was made with the same sheep and under the same general conditions. Sheep No. 1 weighed at the beginning of the experiment 69 kg., and received during the whole time a basal ration of 1,000 gm. of meadow hay and 250 gm. of linseed cake. Sheep No. 2 weighed 56.5 kg., and was fed a basal ration of 750 gm. of meadow hay and 200 gm. of linseed cake. During the first period, which lasted 7 days, each sheep was fed the basal ration, without any additional food. During the second period, which lasted 5 days, 60 gm.

of olive oil was added to the ration of sheep No. 1 and 50 gm. to that of No. 2. In the third period, which lasted 6 days, the amount of oil was increased to 120 gm. and 100 gm., respectively, and in the fourth period, which lasted 5 days, to 180 gm. and 150 gm., respectively.

The coëfficients of digestibility of protein are given for each sheep during each period in the following table:

Coëfficients of digestibility of protein in experiments with sheep.

	Animal.	Protein.
		Per cent.
Hay and linseed cake	No. 1	71.24
Do	No. 2	69.56
Hay, linseed cake, and 60 gm. of olive oil	No. 1	70.83
Hay, linseed cake, and 50 gm. of olive oil	No. 2	69.24
Hay, linseed cake, and 120 gm. of olive oil	No. 1	72.22
Hay, linseed cake, and 100 gm. of olive oil	No. 2	69.00
Hay, linseed cake, and 180 gm. of olive oil	No. 1	70.01
Hay, linseed cake, and 150 gm. of olive oil	No. 2	70.84

The daily nitrogen balance for each sheep for each period is given in the following table:

Nitrogen balance per day in experiments with sheep.

	Animal.	Nitrogen in— Food.	Nitrogen in— Urine.	Nitrogen in— Feces.	Gain (+) or loss (−).
		Grams.	*Grams.*	*Grams.*	*Grams.*
Hay and linseed cake	No. 1	31.65	22.00	9.10	+0.55
Do	No. 2	24.42	17.51	7.43	− .52
Hay, linseed cake, and 60 gm. of olive oil	No. 1	31.65	20.92	9.23	+1.50
Hay, linseed cake, and 50 gm. of olive oil	No. 2	24.42	17.07	7.51	− .16
Hay, linseed cake, and 120 gm. of olive oil	No. 1	31.65	19.01	8.79	+3.85
Hay, linseed cake, and 100 gm. of olive oil	No 2	24.42	16.14	7.57	+ .71
Hay, linseed cake, and 180 gm. of olive oil	No 1	31.65	18.62	9.49	+3.54
Hay, linseed cake, and 150 gm. of olive oil	No. 2	24.42	15.18	7.12	+2.21

The authors discuss the experiment at length. The following are the principal conclusions:

The amount of water drunk was increased by adding fat to the ration, though not proportionately to the amount added. The addition of fat to the ration diminished the excretion of nitrogen in the urine, and this decrease was greater the more fat was added, the limit being reached, in the author's opinion, the first day of the fourth period. In the last days of the fourth period the excretion of nitrogen in the urine increased to about the same as when no fat was added to the ration, though this fact is not shown by the averages quoted above. The addition of the maximum quantity of fat to the ration did not influence the digestibility and assimilation of protein, as was the case when large quantities of starch were added.

The distribution of nitrogen in meat, SALKOWSKI and GEISKE (*Centbl. med. Wiss., 1896, No. 48; abs. in Ztschr. Fleisch- und Milchhyg., 7 (1897), No. 4, pp. 76, 77*).—All meat contains some nitrogen which is

not in the form of nutrients. The author found that 12 per cent of the total nitrogen of meat was nitrogen of extractives, including nitrogen of nonalbuminoid compounds which will not coagulate. This contains not only the meat bases but also protein substances, *i. e.*, albumoses and peptones, and sarco-phosphoric acid recently discovered by Siegfried. If the meat is extracted in the heat this portion of the nitrogenous substances also contains gelatin.

The protein compounds of muscle plasma, VON FÜRTH (*Arch. Path. und Pharmakol.*, *36; abs. in Deut. Tierarztl. Wochensch.*, *4, No. 3; Ztschr. Fleisch- und Milchhyg.*, *7 (1897), No. 4, p. 76*).—The author finds that muscle plasma contains about 20 per cent of paramyosinogin (Halliburton) and 75 to 80 per cent of myosinogin (Halliburton), and also, in the case of frog muscle plasma, myogenfibrin. This is sometimes found in smaller quantities in the muscle plasma of warm-blooded animals. In the author's opinion, Kühne's myosin is the same as Halliburton's paramyosinogin.

Relation of sex in thoroughbred calves, P. COLLIER (*New York State Sta. Rpt. 1894, pp. 125–132*).—To collect data on this subject circular letters were sent to leading breeders of thoroughbred stock of the different breeds. As a result the data are compiled for 68 herds, including 10 breeds, 769 cows, and 3,614 calves, showing number of calves of each sex produced by the cows of each breed in each period of lactation. A summary of these data is given in the following table:

Proportion of calves of each sex.

Breed.	Number of cows.	Number of calves.	Number of bulls.	Number of heifers.	Per cent of bulls.	Per cent of heifers.
Jersey	254	1,273	583	690	45.8	54.2
Holstein-Friesian	209	1,040	517	523	49.7	50.3
Guernsey	110	451	211	240	46.8	53.2
Shorthorn	95	358	180	178	50.3	49.7
Red Polled	51	259	118	141	45.6	54.4
Ayrshire	21	140	77	63	55.0	45.0
American Holderness	3	8	3	5	37.5	62.5
Devon	4	8	4	4	50.0	50.0
Aberdeen Angus	5	16	7	9	43.8	56.2
Galloway	10	33	16	17	48.5	51.5
Jersey grade	7	28	14	14	50.0	50.0
Total	769	3,614	1,730	1,884	47.9	52.1

The bearing of these data on certain theories is discussed. Dividing the time under observation into 4 periods shows the following in regard to the proportion of males and females:

Percentages of male and female births in different periods of lactation.

Period.		Males.	Females.
		Per cent.	*Per cent.*
1	First, second, and third periods of lactation	47.7	52.3
2	Fourth, fifth, and sixth periods of lactation	48.5	51.5
3	Seventh, eighth, and ninth periods of lactation	46.9	53.1
4	Tenth, eleventh, twelfth, and thirteenth periods of lactation	47.5	52.5

"The above shows a very slight increase in the percentage of females, with an increase in the age of the cows.

"In the data collected no fact is so prominently indicated as the prepotency of the cow in determining the sex of her offspring. As a rule it is seen that the numbers of males and females are nearly alike, the latter being in an excess of 8.9 per cent; but among the returns received many instances point emphatically to the predominating influence of the cow herself. . . .

"There were recorded 62 twin calves, or 1.72 per cent of the total number of calves. Of these twins 27, or 45 per cent, were bull calves, and 33, or 55 per cent, heifers, and 16, or 26.7 per cent, were free-martins. . . .

"In regard to the bearing of twin calves the same evidence is seen of individuality of the cow."

Numerous interesting instances of the preponderance of one or the other sex and of twin births are cited to show the influence of individuality.

Sheep-feeding experiments with different nitrogenous feeding stuffs with and without the addition of salt, E. WOLFF, J. MAYER, SIEGLIN, and KREUZHAGE (*Landw. Jahrb., 25 (1896), No. 1, pp. 175–193*).—These experiments, which are in continuation of work previously reported (E. S. R., 4, p. 974), were made with 4 2-year-old grade Württemberg sheep, weighing 52, 50, 49.5, and 47 kg., respectively. The nitrogenous feeding stuffs compared were barley and field beans. The beans and barley were usually fed dry, but in some cases were soaked for 24 hours. They were added in increasing amounts to a basal ration of meadow hay. In general each ration was fed with and without salt. The experiment was divided into 6 periods of 32, 21, 28, 20, 37, and 25 days, respectively.

Full data for each sheep for each period are given in tabular form. The arrangement of the rations and the coëfficients of digestibility for each sheep for each ration are given in the following table:

Coëfficients of digestibility with and without salt.

Period.		Sheep No.	Dry matter.	Organic substance.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.
			Per. ct.	*Per. ct.*	*Per. ct.*	*Per. ct.*	*Per. ct.*	*Per. ct.*	*Per. ct.*
1	Hay with salt	1	56.32	58.77	50.94	43.25	62.83	55.89	21.66
	Do	2	56.14	58.48	49.92	42.43	62.94	55.20	22.87
	Do	3	58.35	60.51	53.31	44.66	64.42	57.72	27.77
	Do	4	56.87	59.10	52.82	38.63	63.70	55.38	25.27
	Average	......	56.92	59.22	51.75	42.24	63.47	56.05	24.39
2	Hay without salt	1	58.71	61.08	54.50	45.63	64.98	58.28	22.02
	Do	2	60.44	62.51	57.26	46.67	65.67	60.66	30.08
	Do	3	57.37	59.66	54.90	42.85	63.50	56.12	24.52
	Do	4	59.28	61.52	53.51	41.74	65.55	59.03	26.42
	Average	......	58.95	61.19	55.04	44.22	64.93	58.52	25.76
3	Hay and barley without salt	1	83.76	86.12	75.28	85.24	91.68	18.34	....
	Hay and beans without salt	3	86.91	87.03	86.53	100.00	93.37	40.07	90.38
4	Hay and barley with salt	1	71.65	73.94	66.01	58.57	80.55	59.39	25.46
	Do	2	71.76	73.91	69.76	58.21	80.36	56.27	28.63
	Do	4	70.57	72.47	71.02	62.13	79.81	49.11	31.89
	Hay and beans with salt	3	70.22	71.80	74.07	51.30	76.72	60.32	42.16
5	Hay and barley with salt	1	74.31	76.31	70.34	62.34	82.97	54.94	32.49
	Do	4	75.56	77.23	76.80	69.68	83.89	49.42	39.00
	Hay and beans with salt	3	73.15	75.14	77.61	55.57	81.74	53.72	32.98
6	Hay, barley, and beans with salt	3	71.36	72.88	73.26	56.36	77.67	57.62	38.12
	Do	4	76.45	78.28	81.98	61.70	84.23	55.91	36.66

The following conclusions were reached:

The opinion of previous years is confirmed that salt has no marked effect on digestibility. The digestibility of soaked and dry beans and of barley is practically the same.

From all the experiments made it is concluded that a ration having a nutritive ratio of 1:7–8 has given as good results as one with a nutritive ratio of 1:4–5. The principal point in feeding full-grown sheep in medium condition is to fatten them as quickly as possible to produce meat of good flavor. To accomplish this it is essential that the ration should be easily digested and appetizing in order that a relatively large quantity may be consumed. This is most easily accomplished when the nutritive ratio is wide, but in the opinion of the authors the flesh is of best quality when the nutritive ratio is medium, about 1:5–6.

The cost of the feeding stuffs and their manurial value are not taken into account in this investigation.

Sheep-feeding experiments with molasses, RAMM (*Deut. landw. Presse, 23 (1896), No. 73, pp. 651, 652, pl. 1*).—An experiment to learn the maximum amount of molasses which could be fed and to compare molasses with other feeding stuffs was made with 6 lambs, 6 months old at the beginning of the test, divided into 3 lots of 2 each. The experiment lasted from August 27, 1895, to March 20, 1896. Lot 1 was fed a ration of 1.4 kg. of hay, 1 kg. of bean meal, and 3.6 kg. of molasses per 100 kg. live weight, and lot 2 was fed 1 kg. of hay, 1 kg. of bean meal, and 4.5 kg. of peat molasses cake. Lot 3 was fed the same amount of hay and bean meal and 2.8 kg. of barley meal. The sheep were slaughtered at the end of the test. The average weight at beginning, gain in weight, dressed weight, weight of tallow and fleece, and profit or loss are given in the following table:

Results of sheep-feeding experiment.

	Weight at beginning (shorn)	Weight at end (shorn).	Dressed weight.	Weight of tallow.	Weight of fleece.	Profit (+) or loss (—).
	Kg.	*Kg.*	*Kg.*	*Kg.*	*Kg.*	
Lot 1 (molasses)	26.00	44.28	20.75	1.540	2.320	+$0.60
Lot 2 (peat molasses cake)	27.80	45.30	27.50	2.485	1.905	+ .14
Lot 3 (barley meal)	26.58	50.07	25.00	2.020	3.300	— 1.69

The dry matter, ether extract, solidifying point, and melting point of the fat and the dry matter, ash, and ether extract in the meat were also determined for each sheep. The following conclusions are drawn:

Without injuring the health sheep can be fed 3.6 kg. of fresh molasses and 4.5 kg. of peat molasses cake per 100 kg. of live weight.

The nitrogen-free extract in the food being the same, the gains on molasses were 82 per cent and on peat-molasses cake 72 per cent of the gain on barley meal.

The production of wool on molasses was 73 per cent and on peat molasses cake 56 per cent of that on barley meal.

The ration containing molasses was much more profitable than that containing barley meal, and molasses was more profitable than peat molasses cake.

The fat produced by the barley ration had a higher melting point than that produced by the ration containing molasses. The barley ration produced flesh with higher percentages of muscular tissue and materials soluble in ether, while the fresh molasses produced more dry matter and ash.

Experiments with geese, S. CUSHMAN (*Rhode Island Sta. Rpt. 1895, pp. 327–358, pls. 4*).—This is a more detailed account of work previously reported (E. S. R., 7, p. 889), and contains in addition the results of the third season's experiments in breeding geese. The following breeds and crosses were tested: Embden-Brown China, Embden-Toulouse, Brown China, Embden-African, Toulouse Brown China, Embden-White China, African-Brown China, African-Toulouse, Pure African, Pure Embden, and Prince Edwards Island. Detailed records of the egg yields for each pen of geese are given in tabular form. The weight of an average specimen of each cross is given, and the live and dressed weights of the geese as exhibited at the winter show of the Rhode Island Poultry Association are tabulated.

"The Embden-African cross were very easy to pick, light colored when dressed, and large, plump, and handsome. The Embden-White China cross picked the easiest of these crosses, were white when dressed, and although small were very plump, and presented the most attractive appearance. . . .

"White China geese are the smallest and weakest of all breeds, but lay early and late in the season a great number of large eggs, and if mated with the Embden ganders produce vigorous, quick-growing goslings, which are very plump and solid. . . .

"For trade that requires a large goose at Christmas or New Year's the Embden-Toulouse would be most suitable of these crosses. Pure Africans, Embden, and Embden-African crosses get their best growth early in the season, and should be sold early. Pure Brown Chinas, African-Toulouse, and African-Brown China crosses should be dressed before fall, in order that they may pick well. . . . The white-plumaged Embden and the crosses that are white are comparatively easy to pick even in the fall."

The following conclusions are some of those drawn from all of the author's experiments with geese:

Old geese lay a greater number of larger eggs and are more reliable than young geese. Nevertheless, if geese must be purchased it often saves time to buy young geese rather than to attempt to secure any number of old ones. Young ganders are better for breeding than young geese. Young geese do not lay as many fertile eggs or produce as many goslings the first breeding season as they do the second. If geese are often changed from one place to another, they are apt not to breed well, and the other conditions being equal they breed better the third season they are in a locality than the second.

"Breeding geese should be secured as early in the fall as possible, not later than October, to insure the best results. This gives them sufficient time to become

acquainted with their new surroundings and feel thoroughly at home before the breeding season. Breeding geese should be kept active and moderately thin in flesh through the winter by light feeding, and by allowing them free range, or such facilities for swimming as will induce them to take much exercise. If deprived of the latter they must not be fed much fattening food. [In Rhode Island] they require no houses or protection from cold or storm, and seem to prefer to stand out exposed to the wind in midwinter rather than seek the protection of an open shed, except during a heavy snowstorm.

"Geese are grazers, and can be spoiled by too much grain. To insure the fertility of eggs, access to a pond, puddle, or a tub of water set level with the ground, as well as an abundance of green food, is of the greatest importance.

"African and Brown China ganders mate more quickly than other kinds and are the most prolific and sure breeders. Toulouse ganders are sluggish, slow to mate, and as breeders are the least reliable. Toulouse geese are great layers, and some specimens do not offer to sit. Embden geese are more inclined to sit than Toulouse, and make better mothers, but lay fewer eggs. Brown China and White China geese are very prolific layers. Very early laying is not desirable, as goslings hatched before grass is plenty do not do well and cost more than they bring. Goslings do best when put out during the day on short grass with water to drink, no other food but grass being given for two days, and then a light feed of scalded cracked corn three times daily in addition to the grass. The supply of grass should always be ample, and the water dish should never become empty. They should always have an opportunity to get into the shade or they are liable to be overcome by the heat of the sun."

Dictionary of technology and allied sciences (*Lexikon der gesammten Technik und ihre Helfswissenschaften, 1896, pt. XVIII; Deutsch. Verlags-Anstalt, Stuttgart and Leipzig; rev. in Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), No. 24, p. 396*).—This contains an article on meat preparations.

Analyses of foods, condiments, and some commercial products, M. MANSFELD (*Die Untersuchung der Nahrungs- und Genussmittel, sowie einiger Gebrauchsgagenstände. Vienna and Leipzig: F. Deuticke, pp. 168, figs. 24; rev. in Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), No. 24, p. 396*).—A laboratory manual and text-book.

Analyses of bean straw, stalks, and pods (*New York State Sta. Rpt. 1894, pp. 135, 136*).—Analyses are given of bean straw from pea beans and red kidney beans, of bean stalks, and of pods of red kidney beans.

Sugar in corn stalks (*New York State Sta. Rpt. 1894, pp. 134, 135*).—The amount of sugar in the juice of a number of sorts of corn stalks was determined.

Analyses of feeding stuffs, M. B. HARDIN (*South Carolina Sta. Rpt. 1895, pp. 52–54*).—Tabulated analyses of cotton-seed meal, "Brewery feed," "Corn Chops," sugar beets (sugar content), sweet potatoes (water and starch content), and millet seed (water and starch content).

VETERINARY SCIENCE AND PRACTICE.

Crimson clover hair balls, F. V. COVILLE (*U. S. Dept. Agr., Division of Botany Circ. 8, pp. 4, figs. 3*).—Notes are given on the occurrence in the stomach and intestines of horses of large balls composed of the hairs from the calyx of the crimson clover. Numerous cases are cited in which these have caused the death of animals, and it is recommended that overripe crimson clover should not be fed. The hairs are peculiarly constructed so as to collect together and form large masses. The hairs do not become stiff until after the flowering stage, therefore crimson clover should not be fed after that time. The practice of

feeding stock with straw from crimson clover which has been threshed as a seed crop is condemned.

The application of tuberculin in the suppression of bovine tuberculosis, B. BANG (*Massachusetts Hatch Sta. Bul. 41, pp. 27*).—This is a translation of an article in a German veterinary journal,[1] treating of the prevalence of tuberculosis in Denmark and discussing the author's work with tuberculin in that country, the provisions of the law, the distribution of the disease in the different provinces, and the relative prevalence of the disease in large and small herds. The author found that 59.8 per cent of the animals in herds of 50 or more were affected by the disease, while only 32.2 per cent were affected in smaller herds. He also found that single injections of the tuberculin would suppress for a year susceptibility to the test, and does not consider it safe to conclude in such cases that an animal has been cured because it does not react. The tuberculin does not in any large number of cases coming under the author's observation produce a worse condition than before the test. He believes it safe to raise the calves from cows which react to the tuberculin but otherwise appear healthy; in but very few cases did he find evidences of tuberculosis in the calves.

A somewhat extended account is given of an experiment in eradicating tuberculosis from a herd consisting of 208 head of cattle which were quartered in a large stable. Upon the application of the tuberculin test 131 animals were found to react, while 77 appeared healthy. The stable was then separated into 2 parts by a board partition lined with building paper, and the infected animals were isolated in one portion of the stable. All of the calves which reacted were immediately killed, and all cows reacting which during the year showed noticeable clinical evidence of tuberculosis were also slaughtered. The animals in the healthy division were inoculated twice yearly, just before and after pasturing. All heifer calves and several males were raised; but immediately after birth those born from animals in the infected section were removed and placed in the healthy division. These, however, were kept in partial isolation and inoculated with tuberculin. This precaution proved to be superfluous, for in the 4 years during which the test was continued only 2 calves were born with tuberculosis.

Every possible precaution was taken to prevent communication between the healthy and unhealthy divisions, and the entire stable was carefully disinfected each spring. In 4 years the number of animals in the reacting division decreased from 131 to 69 and the number in the healthy division increased from 77 to 132, while the number of reacting animals in the healthy division diminished from 10 in the second year to 2 in the fourth year.

The author believes these figures show the practicability of eradicating tuberculosis without the complete destruction of the herd.

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[1] Deut. Ztschr. Thiermed., 22 (1896).

Results of the use of tuberculin in the Castlecraig herd, J. WILSON (*Edinburgh: G. P. Johnston, 1896, pp. 15*).—An account is given of an attempt to eradicate tuberculosis from a private herd of about 80 animals without the immediate destruction of all reacting animals. At the first test made in March, 1895, 16 animals (about 20 per cent of the herd) were found to be tuberculous and were separated from the herd. This testing and separating process has been continued; the calves born were reared, but all tuberculous animals which showed themselves unfit for breeding purposes through udder infection were slaughtered. The test made in November, 1896, showed that the percentage of tuberculous animals in the herd of 83 animals had been reduced to 10.84. The author believes that the spread of the disease has been completely arrested. Full records of the tests are given in tables and comments.

Charbon, or anthrax, S. B. STAPLES and W. H. DALRYMPLE (*Louisiana Stas. Bul. 44, 2d ser., pp. 30, pl. 1*).—A popular bulletin giving the history, character, general symptoms, symptoms in the different domestic animals, treatment, and sanitary and hygienic measures. Notes are also given upon experiences of the authors during a severe outbreak of the disease in the State during the spring of 1895. The authors say, "We have nothing new to offer for the enlightenment of the scientific medical world."

Distemper in horses and mules, W. E. A. WYMAN (*South Carolina Sta. Bul. 25, n. ser., pp. 11*).—This is a popular bulletin on strangles and influenza, giving symptoms and treatment for each.

Founder in horses, W. E. A. WYMAN (*South Carolina Sta. Bul. 26, n. ser., pp. 3–11, figs. 4*).—A popular discussion on founder or laminitis of horses, with a description of the parts affected, causes, symptoms, prevention, and treatment.

Red water in cattle, W. E. A. WYMAN (*South Carolina Sta. Bul. 26, n. ser., pp. 12–16*).—A discussion of the cause, symptoms, course, prevention, and treatment of hemoglobinuria or red water in cattle, which is under investigation at the station.

Texas cattle fever, W. M. MILLER (*Nevada Sta. Bul. 31, pp. 15*).—This includes a reprint of a press bulletin issued by the station giving a general discussion of the disease, the history of an epidemic originating in the State in 1894, the cause and means of dissemination, symptoms and pathological conditions, treatment, and measures to prevent its introduction into the State; an extract from a bulletin on Texas fever in California; and the regulations of this Department concerning cattle transportation.

Bovine tuberculosis in north Louisiana, W. C. STUBBS, S. B. STAPLES, and W. H. DALRYMPLE (*Louisiana Stas. Bul. 43, 2d ser., pp. 20*).—An account is given of the unexpected appearance of tuberculosis in the station herd at Calhoun, and of tuberculin tests made upon the animals. Temperature records are given and data regarding yield and composition of milk before and after the injection. Six of the 22 animals responded to the test, but the cow most seriously affected did not react. This animal was slaughtered, and the others isolated. The attempt is to be made to breed out the disease.

Tuberculosis in cattle, E. A. A. GRANGE (*Michigan Sta. Bul. 133, pp. 3–13*).—A popular bulletin giving a brief historical sketch of the disease; methods of dissemination of the virus, special attention being called to danger of transmission through food manipulation in carelessly managed stables; and the symptoms of the disease and its diagnosis by clinical and microscopical examinations and by the tuberculin test. Some data are given upon cases treated by the author and an outline of the experimental work upon this disease to be carried out at the station. A particular instance is noted of the probable infection of calves through the milk of a diseased cow, and details of some inoculation experiments with guinea pigs.

Tuberculin tests (*Rpt. Vermont State Bd. Agr. Cattle Commissioners, 1896, pp. 14–17, 32, 42*).—In tests made under the auspices of the Vermont State Board of Agriculture 924 animals of 14,155 examined reacted and were killed and all but 4 were found to be diseased.

Check lists of the animal parasites of ducks and pigeons, A. HASSALL (*U. S. Dept. Agr., Bureau of Animal Industry Circs. 13, pp. 7; 15, pp. 4.*)—Lists are given of species of Protozoa, Trematoda, Cestoda, Nematoda, Acanthocephala, Arachnida, and Insecta infesting ducks and pigeons. The synonymy of genera and species and the location affected by each parasite are given.

Diseases and enemies of poultry, L. PEARSON and B. H. WARREN (*Pennsylvania Dept. Agr., pp. 128, pls. 6, figs. 32*).—The bulletin contains chapters on diseases of the skin, the respiratory organs, digestive organs, egg-producing organs, brain and eye, legs and feet, bones, and contagious diseases. There are also chapters on a number of "furred and feathered enemies of domestic fowls."

Tenth and Eleventh Annual Reports of the Bureau of Animal Industry (*U. S. Dept. Agr., Bureau of Animal Industry Rpts. 1893 and 1894, pp. 127*).—An account is given of the transactions of the Bureau for 1893 and 1894. The following topics are treated in special articles: Prevalence of anthrax among domesticated animals; Extirpation of *maladie du coit*, by G. C. Faville; Prevalence of tuberculosis among cattle in New York, by E. C. Schroeder; Injuries to cattle from swallowing pointed objects, and Preliminary investigations of unknown diseases in turkeys, by T. Smith; Black quarter and Actinomycosis or lumpy jaw, by D. E. Salmon; Australian meat trade, by A. and M. Reynolds. Miscellaneous notes are given upon the Florida horse leech, tuberculosis among cattle in Saxony, *Xanthium strumarium* (cockle bur), meat importation, and stock hogs for market, and additional State laws relative to the control of contagious animal diseases are quoted.

DAIRY FARMING—DAIRYING.

Investigations on the effect of the seed of common vetch on milk secretion, W. J. QUICK (*Inaug. Diss. Halle, 1896, pp. 44*).—Following a general discussion of the value of vetch for cows, a feeding experiment with 3 cows is described in which vetch seed was compared with peanut cake during 4 periods varying from 7 to 15 days in duration, with intermediate periods. The cows were of different breeding and in different stages of lactation. The feeding trial was not made simultaneously with all the cows, and the composition of the rations was not uniform, as one of the cows was near calving.

The rations were composed of alfalfa hay, barley or rye straw, beets, palm-nut meal, rice meal, and peanut cake or vetch seed, rye and wheat bran also being added in the case of one cow. The peanut cake and vetch seed were the only varying elements, 5.22 to 5.62 lbs. of vetch seed per 1,000 lbs. live weight being fed in comparison with 2.44 to 2.72 lbs. of peanut cake. The peanut-cake ration was fed the first two periods, the ground vetch seed the third, and the peanut cake again the fourth period. The yield, specific gravity, and fat content (by Soxhlet's aërometric method) of the milk were determined, and in case of one cow other determinations were occasionally made. These data, together with the live weight, are tabulated in full. A summary follows.

Comparison of peanut cake and vetch seed on cows.

	Peanut cake.		Shrinkage between periods 1 and 2.	Vetch seed. Period 3.	Shrinkage (−) or gain (+) between periods 2 and 3.	Peanut cake. Period 4.	Shrinkage between periods 3 and 4.
	Period 1.	Period 2.					
Average daily milk yield (pounds):							
Cow No. 388	20.86	17.56	3.30	14.60	− 2.96	11.10	3.50
Cow No. 554	21.20	20.88	.32	20.60	− .28	14.17	6.43
Cow No. 556	48.60	48.04	.56	50.41	+ 2.37	47.04	3.37
Average daily yield of fat (grams):							
Cow No. 388	435.4	371.2	64.2	283.4	−87.8	228.3	55.1
Cow No. 554	....	337.3	....	329.6	− 7.7	279.2	50.4
Cow No. 556	....	775.2	....	790.1	+14.9	756.4	33.7

Cow No. 388, which was in the thirteenth month of lactation, shrunk the most and suffered from an attack of indigestion in the intermediate period between periods 2 and 3. The author concludes that "the vetch seed gave either a real gain or a diminished shrinkage over the peanut cake in the preceding or subsequent periods." The live weight was maintained on the vetch ration. The cows with calf showed no ill effects from the vetch seed, contrary to tradition.

Incidentally, the Soxhlet aërometric method was compared with the Babcock test, the former being stated as the more exact.

Winter feeding experiments with dairy cows, F. B. LINFIELD (*Utah Sta. Bul. 43, pp. 35–59*).—These experiments were made with 2 lots of 5 cows each, fed in 8 periods of 3 weeks each. During the first 7 periods lot 1 received alfalfa hay and lot 2 mixed hay *ad libitum*. In addition both lots received a grain mixture of equal parts by weight of wheat and bran, of which 6 lbs. per head daily was fed during the first period, 10 lbs. during the second, 12 lbs. during the third and fourth, 10 lbs. during the fifth, 8 lbs. during the sixth, and 6 lbs. during the seventh. In some cases the cows refused to eat these amounts of grain. In the eighth period the cows were at pasture and received no grain. The milk was weighed morning and evening and composite tests were made. The data are fully tabulated for each animal, with averages by lots, showing amounts and cost of food eaten and the yield and composition of the milk; and these data are fully discussed.

The author's summary follows:

"(1) This test adds but another item to the fairly well established fact that an increase in the quantity of concentrated food in the ration of a cow does not increase the richness of the milk, provided the cows are well fed to start with.

"(2) Any increase in the grain fed over 6 lbs. per day, increased the cost of the dairy products almost without exception; and the test indicates that, with the fodders used, 8 lbs. of grain is the highest limit for the greatest profit.

"(3) Considered from the point of price, alfalfa hay and grain seem to be a more economic ration than one of mixed hay and grain, but considering the weight of food, there is very little difference, though the results are slightly in favor of alfalfa.

"(4) It is evident from these tests that, with the price of alfalfa as reported ($3.75 per ton), cows may be fed at a food cost in winter of less than 9 cts. a day per 1,000 lbs. live weight, even with cows that will produce 1 lb. of butter or more a day.

"(5) The test also shows that, with the right kind of cows, butter fat may be produced during the winter at a cost of not more than 9 cts. per pound.

"(6) The cows which were the largest eaters were, without exception, the largest and most economic producers."

Some observations were made on the morning and evening milk, the composite samples being kept separate for testing. The period between night and morning milkings was 13 hours and between morning and night milkings 11 hours, so that the morning's milk was from the longer time. The author states that almost without exception the evening's milk was much richer than the morning's milk throughout the whole winter, while the yield was almost invariably larger in the morning. The largest average variation in composition for the whole time was 1.5 per cent in the case of a Jersey heifer.

"[In the case of this cow] while the weight of milk given each month is greater in the morning than in the evening, yet the weight of fat is uniformly greater in the evening, or, in other words, there was more fat secreted by the cow during the 11 hours of the day than during the 13 hours of the night."

Dairy herd record for 1894–'95, F. B. LINFIELD (*Utah Sta. Bul. 43, pp. 1–34, figs. 8*).—The record is given for 15 cows for 1 year beginning June, 1894. With 2 or 3 exceptions the cows were natives and grades. They were of different ages and in different stages of the period of lactation. The method of keeping the record is described, and the Babcock test and its use in paying for milk, the merits of paying for milk by weight and by test, and the food given the cows are discussed, together with the composition of alfalfa hay, mixed hay, green fodder (principally alfalfa), wheat, barley, and bran. The data are tabulated in detail, showing for each cow in each month the weight, yield of milk, fat content of milk, calculated yield of butter fat, cost of food eaten, and cost per pound of butter fat, and these data are summarized. The following table gives a summary for the year of the more important data:

Summary of herd record for the year.

Cow.	Weight of cows.	Cost of feed.	Yield of milk.	Cost of 100 lbs. of milk.	Yield of butter fat.	Yield of butter.	Cost of 1 lb. of butter.	Yield of butter per 100 lbs. live weight.	Net returns. With milk at 70 cts. per 100 lbs.	Net returns. With butter at 20 cts. per lb.
	Lbs.		*Lbs.*	*Cts.*	*Lbs.*	*Lbs.*	*Cts.*	*Lbs.*		
No. 1	1,191	$21.58	5,148.9	41.91	156.70	182.81	11.80	15.34	$14.46	$14.96
No. 2	1.101	17.80	5,820.3	30.58	218.11	254.46	6.99	23.11	22.94	33.09
No. 3	976	21.65	6,801.0	31.83	313.41	365.64	5.91	37.46	25.95	51.37
No. 4	1,029	25.58	4,912.1	52.07	250.00	291.66	8.77	28.34	8.80	32.75
No. 5	1,007	20.90	9,087.9	29.48	258.87	302.91	6.91	30.00	28.71	29.50
No. 6	914	20.07	4,196.0	47.83	156.00	182.00	11.02	19.91	9.30	16.33
No. 7	965	25.00	5,424.8	46.09	227.77	265.73	9.40	27.52	12.98	28.14
No. 8	992	24.89	7,156.1	34.78	303.03	353.53	7.04	35.63	25.20	45.81
No. 9	911	19.71	6,367.5	30.95	271.89	317.20	6.21	34.82	24.86	43.73
No. 10	966	25.82	5,479.4	47.12	223.77	261.06	9.88	27.02	12.53	26.39
No. 11	989	18.74	5,272.0	35.55	213.54	249.13	7.51	25.18	18.16	31.08
No. 12	909	23.88	4,868.1	49.05	203.32	237.20	10.06	26.09	10.19	23.56
No. 13	1.035	26.71	6,720.3	39.74	280.26	326.97	8.17	31.59	20.33	38.68
No. 14	889	19.61	3,917.7	50.05	147.09	171.60	11.42	19.30	7.81	14.71
No. 15[1]	675	10.00	2,303.1	43.42	102.82	118.79	8.33	17.61	6.12	13.75
Average[2]	991	22.28	5.655.1	40.50	230.27	268.74	....	....	17.30	31.47

[1] Record for six months. [2] Average without No. 15.

The cost of food is based on the following prices: Alfalfa hay at \$3.75, mixed hay at \$6.75, green fodder (principally alfalfa) \$1.25, wheat \$12.66, barley \$15, and bran \$9 per ton, and pasturage \$1 per month per head.

"The yearly records of the cows are not phenomenal, but they present a very fair average, considering the condition of the cows when they came on the farm. The yearly milk record ranged from 3,917 lbs. to 7,156 lbs., and averaged 5,655 lbs. The butter fat produced ranged from 147 lbs. to 313.4 lbs., and averaged 230.27 lbs. The butter, which may be calculated by adding one-sixth to the butter fat, ranged from 171.6 to 365.6 lbs. and averaged 268.7 lbs. per cow. In butter production 11 of the 14 cows gave over 200 lbs. of butter a year; 9 of these cows gave over 250 lbs. in a year; of the 9, 5 gave over 300 lbs. and 2 of the 5 gave over 350 lbs. of butter in the year.

"Of the common cows, 4 gave over 300 lbs. of butter in a year. One gave over 350 lbs., but it is to be noted that she was milked for 365 days. She carried a calf, however, for the last 6 months of the year. . . .

"With good cows the people of Utah can produce dairy products cheaper than they can be produced in many of the great districts of the East. . . .

"Even at 15 cts. a pound for butter fat some of the cows gave a very fair net return. . . .

"At the present prices of dairy products as compared with the price of grains and fodders, one dollar's worth of feed fed to a good herd of cows will return two dollars' worth of milk, butter, or cheese."

In buying the cows they were tested as to yield and fat content of milk. This was not found to give very reliable information as to the value of the cow for dairy purposes, as there were wide differences in the way in which the cows behaved during the year, some of them showing a tendency to decrease rapidly early in the stage of lactation.

"Tests in connection with the weights of the milk morning and evening, taken for the sixth month after the cow comes in, seem in the majority of cases to indicate not only the probable value of a cow, but her relative value as compared with the other cows of the herd."

Some points from feeding milch cows, P. COLLIER (*New York State Sta. Rpt. 1894, pp. 122–124*).—This is a discussion of some of the data obtained in 14 feeding experiments with cows, described in detail in Bulletin 80 of the station (E. S. R., 7, p. 57). Certain data from these experiments are tabulated, showing the food constituents consumed and the milk constituents produced.

"The average number of pounds of food digested daily was 13.71, and the average number of pounds of milk constituents (fat, casein, and sugar) produced daily amounted to 3.60 lbs. and, therefore, there was required 3.76 lbs. of digested food for each pound of milk solids produced; also, for the production of 1 lb. of fat in milk there was an average expenditure of 16 lbs. of digestible food.

"In the expenditure of energy over and above that needed in the production of milk, there was a daily average sufficient to raise the temperature of the entire cow 80° F., or raise 407.4 lbs. of water from 32 to 212° F.

"As an average of all the experiments, it appears that the fat produced in the milk was 11.9 per cent in excess of the fat digested in the food; that the casein produced in the milk was but 38.5 per cent of the protein digested in the food, while the nonnitrogenous matter digested in the food was 5.45 times greater than that produced in the milk.

"It will be seen that in the case of these animals, when the production of fat was approximately at its best, the digested fat of their food was nearly sufficient to meet the demand. . . . As the result of 4 years' experiment with our seven breeds of cattle, we have as follows:

	Pounds.
Crude fat in food fed	24,358
Pure fat in food fed (82.6 per cent)	20,119
Pure fat in food between lactation periods	631
Fat in milk	17,754

"From which it will appear that there was consumed by these various animals 16.9 per cent more fat than was produced by them in their milk."

A preliminary bulletin on the pasteurization of milk, C. D. SMITH (*Michigan Sta. Bul. 134, pp. 15-43, figs. 6*).—This is a popular bulletin on the pasteurization of milk, treating briefly of the micro-örganisms in milk, the sources of infection, pathogenic bacteria, diseases traced to infection through milk, prevalence of tuberculosis among cows, the need of regular official inspection of dairy herds, and milk preservation. Under the latter head the pasteurization of milk is described in considerable detail, the requisites to pasteurizing being enumerated, and illustrated descriptions given of several simple methods for household use and of the De Laval and Russell apparatus for sterilizing milk on a commercial scale. The description of the latter is reprinted from Wisconsin Station Bulletin 44 (E. S. R., 7, p. 987).

It is explained that "the chief object of pasteurizing milk at home is to kill the germs of disease, and this is accomplished in one form of apparatus as well as another if the entire mass of milk is kept at 155° F. for the requisite time." The author has found an ordinary wash boiler filled with water up to the level of the milk in the tin cans entirely satisfactory. Perforated tin pie plates are placed in the bottom of the boiler and the cans set upon these. The water is heated to 160° F. and the cans of milk then placed in it without covers and stirred at frequent intervals until the temperature of the milk reaches 155°. The covers are then put on the cans and the boiler, and the latter set on the back part of the stove. After the milk has been kept at 155° for 20 minutes the cans are removed and placed in ice water. Repeated experiments have shown that with straight-sided tin cans 3 in. in diameter and 7 in. deep the milk was cooled to below 50° in less than 15 minutes.

"For hotels and large boarding houses we have no apparatus that gives more promise of cheapness, ease of management and efficiency than simple shotgun cans and a boiler made to order as high as the cans are deep and long enough to hold at least three of the cans. These cans are 8 in. in diameter and 22 in. deep, and hold conveniently 37 lbs. of milk."

Two trials are reported on the keeping quality of milk sterilized commercially by the De Laval apparatus.

The testing of rennet preparations, and the curdling of milk with cheese rennet, A. DEVARDA (*Landw. Vers. Stat., 47 (1896), No. 6, pp. 401-447*).—The following method is given for determining the efficiency of rennet preparations, which is a modification of Soxhlet's

method[1]: Two hundred cubic centimeters of fresh, normal cows' milk is heated in a 300 cc. flask to 35° C. (not higher), 2 cc. of rennet solution added and the heating continued in a constant water bath with frequent gentle agitation until the milk is curdled. After a few minutes' heating the milk will become thick and will appear cheesy and stringy on the glass. The temperature must be kept at exactly 35°. In preparing the rennet solution for the test 10 cc. of rennet extract or 1.25 gm. of rennet powder is made to 200 cc. with water. Representing by t the time required for coagulation the curdling power of rennet extracts is $\frac{80,000}{t}$, and of rennet powders $\frac{640,000}{t}$.

The author made many experiments to study the effect of various properties of the milk and other factors on the action of rennet and on the rennet test. The results of these are tabulated and discussed at length.

Using a given rennet solution, the time of coagulation varied with the milk of the same cow at different times, the maximum variation being about 1 minute. On an average the morning's milk required about 0.55 minute less for coagulation than that milked at noon, although the specific gravity, fat content, and acidity were practically uniform. With the mixed milk of several cows the differences were much smaller. The morning's milk was found to be much more regular than the noon milk, and is believed to contain more lime salts. It is suggested that a study of breed differences in this respect would be interesting.

Skimming milk (without allowing it to sour) had practically no effect on the rennet test; and likewise the addition of a refined, nearly neutral oil of about the same specific gravity as milk fat had only slight effect.

Goats' milk curdled in considerably less time than cows' milk. Milk preservatives, as was to be expected, affected the curdling. The acidity of the milk was found to be the principal controlling factor. The author recognizes three kinds of acidity of milk, (1) the original acidity attributed to the ability of casein to take up bases leaving acid phosphates, (2) that due to lactic acid produced in the milk, and (3) that due to carbon dioxid (very small). The effect of the first two is quite different. The first is due to the presence of monopotassium phosphate and casein in milk. The monophosphate is shown by experiment to act principally by rendering more soluble the nearly insoluble calcium phosphates of the milk. Trials of adding to milk different amounts of a solution of monopotassium phosphate of known strength showed that in spite of the increased acidity of the milk the time of coagulation of the milk was only slightly decreased, while an equivalent increase in the acidity from adding a free acid affected the coagulation very much. This is thought to account for the great instability in the solubility of the calcium phosphate of milk, which is greatly affected by outside influences, and so affects the curdling of the milk.

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[1] Milch Ztg., 6 (1877), p. 513.

Experiment showed that the action of rennet is favored by free acids in the milk, first, by dissolving the insoluble calcium phosphates of the milk, until the limit of this is reached; then by their action and decomposition of the calcium-casein compounds in the milk, whereby the casein gradually changes to a form insoluble in milk, and consequently a more favorable proportion for the action of rennet is brought about between the soluble casein and lime salts in the milk. With the increase of lactic acid the curdling power is increased until the milk curdles merely on heating. Free acids do not of themselves affect the action of rennet, which depends not upon the absolute but only the relative amount of casein and soluble lime salts. Hence their action is only indirect. The ability of milk to curdle with rennet bears no relation to its natural acidity; this is clear when it is remembered that the apparent acidity stands in no relation to the quantity of soluble lime salts in milk. But in this connection it should not be forgotten that the dipotassium phosphate in milk slightly increases its acidity and at the same time has an unfavorable action on the solubility of lime salts, which is shown by an experiment.

The action of carbonic acid is different from that of other free acids, being similar to that of monophosphates.

The addition of water to milk diminishes its curdling power noticeably in proportion to the quantity added. This is believed to be due to a diminished solubility of the suspended lime phosphates as a result of the dilution of the dissolving salts; a part of the dissolved lime salts are precipitated by diluting, changing the proportion between the casein and soluble lime salts, and consequently diminishing the curdling power of the milk.

Heating milk above 35° C., and cooling to a low temperature, both have an unfavorable effect on the curdling of milk by rennet. Continued boiling of milk renders it incapable of curdling in a reasonable time. The cooling of milk from the temperature when milked (about 36° C.) down to the air temperature (15 to 17° C.) increased the time of curdling about 0.3 minute. The ability of milk to curdle is at the optimum when it is fresh and warm from the cow; begins to diminish at once, and only becomes constant when the temperature of the surrounding air has been reached, after which it increases as a result of the development of lactic acid. In a number of experiments in which milk was cooled to 2° or 0° C. the time afterwards required for curdling with rennet was increased 0.11 to 0.79 minute. A sample of milk was kept at 0° C. for 4 days. During this time the acidity showed no increase, but the time of curdling with rennet gradually increased from day to day. Hence, although the action of bacteria was checked, there was a gradual separation of lime salts, and possibly also a change in the solubility of the casein salts, both of which affect the curdling.

Vigorous shaking of milk free from carbon dioxid slightly prolonged the time required for curdling, as did also treatment of partially sour milk with an electric current.

In studying the practical application of the use of a control rennet in testing rennet preparations, it was necessary to determine (1) whether the time required for curdling normal and abnormal milk under corresponding conditions is always exactly inversely proportional to the strength of the rennet solution, and (2) whether the values of 2 different rennet preparations bear a constant relation to each other when tested with milk of different origin. These questions were studied on various samples of normal and abnormal milk, and the following conclusion reached: Using ordinary fresh pure milk, the time required for curdling with rennet is not exactly inversely proportional to the strength of the rennet solution, but is always somewhat shorter than the estimated time, the difference depending upon the length of time required for the curdling. With sterilized milk, however, this proportion is exact, *i. e.*, the time required for curdling (normal and abnormal) *sterilized* milk is exactly inversely proportional to the strength of the rennet solution; and the values of 2 different rennet preparations, determined with different samples of sterilized (normal and abnormal) milk, always bear a constant relation to each other.

Directions are given for the selection, determination of efficiency, and use of a control rennet. A pure homogeneous powder of medium strength is selected, and this kept in the dark should not change in two years. In testing its strength fresh normal mixed milk from a large number of cows should be used and the average of at least 12 determinations taken. In determining the strength of commercial rennet preparations with the aid of this control rennet, fresh solutions are to be made up each time of the strength already mentioned; and unless the milk used is known to be extremely clean and free from infection it is to be pasteurized by heating from one-half to three-quarters of an hour at 75° to 80° C.

The author mentions the application of the rennet test in the milk control, especially its value in detecting the addition of sodium carbonate, and in determining whether milk has been sterilized and to what extent.

Dairyman's report, J. W. HART (*South Carolina Sta. Rpt. 1895, pp. 68–72*).—A summarized record is given for each cow in the station herd, showing for one year the yield of milk and of butter fat, the average percentage of fat in the milk, and the pounds of milk to each pound of calculated butter.

The following method is used in paying the students for milking:

"Under the present system each milker milks about 8 cows. He is paid monthly 25 cts. for each cow milked and 8 cts. for each 100 lbs. of milk. In addition, three prizes of \$3, \$2, and \$1 each are paid every month to the milkers whose cows hold up the best in their milk, as shown by comparing the amounts of milk obtained at the first and last of the month. Under this plan the milkers take a keen interest in sustaining the milk flow of the cows by every means at their command, while the cost of milking does not exceed 1½ cts. per gallon."

The station conducted a coöperative creamery during the season, receiving milk from some 23 patrons.

The investigation of different breeds of dairy cattle, P. COLLIER (*New York State Sta. Rpt. 1894, pp. 9–121*).—This is a continuation of the investigation which has been in progress for several years, previous accounts of which have been given in the Annual Reports of the station for 1891, 1892, and 1893 (E. S. R., 4, p. 255; 6, pp. 68, 1013). The record includes 26 cows of the following breeds: Ayrshire, Jersey, American Holderness, Guernsey, Devon, Holstein-Friesian, and Shorthorn. The report consists almost entirely of tabulated data, with practically no general discussion. The data given include the amount of food fed to each cow during each period of lactation; analyses of the feeding stuffs, *i. e.*, corn silage, mixed hay, corn stover, clover hay, timothy hay, alfalfa forage, oat and pea forage, beets, ground oats, and wheat bran, and several grain mixtures; the food ingredients fed to each cow in each period of lactation; the composition of the milk by months; the cost of production of milk and fat for each cow in each period of lactation; summaries as to the yield and composition of milk and the cost of production; yields of milk in the morning and evening in each period of lactation; the average yield and fat content of milk for each cow in each period of lactation, and the relation of fat in the food to fat in the milk.

A comparison of these breeds for milk, butter, and cheese production has been given in Bulletins 77, 78, and 79 of the station (E. S. R., 7, pp. 45–47).

The chemistry of dairying, H. SNYDER (*Easton, Pa.: Chemical Publishing Co., 1897, pp. VIII, 156, pls. 2, figs. 21*).—This is an elementary text-book, intended to furnish "useful information to a class of young men who intend to become farmers and dairymen, rather than scientific experts." The author has made a wise selection of material, which he has presented in an attractive form in plain, concise language.

Beginning with the composition of milk and the character of the separate ingredients, the methods of testing milk are described, the chemistry of butter making and cheese making, and the preservation of milk by sterilizing, pasteurizing, and condensing, are discussed; the composition of skim milk, buttermilk, and whey, and of the milk of other domestic animals, is given, together with the sanitary condition of cows' milk, the effect of food upon the quality of dairy products, and the adulteration of dairy products, concluding with a chapter on the composition of fodders and the calculation of rations. At the end of each chapter a considerable number of references are given to books and bulletins relating to the subjects treated, and in an appendix review questions for classroom use are given. The book has a good index.

The improvement of a strain of milch cows in Wiesbaden, R. MÜLLER (*Milch Ztg., 25 (1896), No. 46, pp. 729–731*).

Is milk production a breed characteristic? (*Deut. landw. Presse, 23 (1896), No. 701, pp. 896, 897*).—A review of the studies of T. L. Haecker on the relation between milk production and the type and conformation of cows, published in Minnesota Station Bulletin 35 (E. S. R., 6, p. 925).

The advantages of testing the fat content of individual cows in a herd, B. MARTINY (*Deut. landw. Presse, 23 (1896), No. 101, p. 897*).

Examination of the milk of individual cows, P. VIETH (*Ztschr. landw. Ver. Hessen, 1896, No. 48, pp. 409–411*).

Cattle feeding, W. P. WHEELER (*New York State Sta. Rpt. 1894, pp. 180–262*).—General remarks are given regarding the manner of feeding the cows in the station herd at different stages during the year, and an account of experiments in feeding alfalfa forage to milch cows reprinted from Bulletin 80 of the station (E. S. R., 7, p. 57).

Comparison of different breeds of dairy cattle with reference to the production of milk, L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 268–304*).—A reprint of Bulletin 77 of the station (E. S. R., 7, p. 45).

Comparison of different breeds of dairy cows with reference to the production of cream and butter, L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 305–350*).—A reprint of Bulletin 78 of the station (E. S. R., 7, p. 46).

Comparison of different breeds of dairy cows with reference to the production of cheese, L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 351–451*).—This is a reprint of Bulletin 79 of the station (E. S. R., 7, p. 47) with the following added data: Cost of food eaten, yield of milk and milk constituents and cost of the same, yield of butter, amount of milk required per pound of butter, cost per pound of butter, and the butter record for each cow in each month of lactation.

Note on the concentration of condensed milk, A. H. ALLEN (*Analyst, 21 (1896), Nov., pp. 281, 282*).—Formulas are given for calculating the water to be added to condensed milk to dilute it to its original consistence and for calculating the solids and fat in the diluted milk. A table shows for 12 brands the amounts of water to be added for cooking and ordinary use, and for infant's use.

Calculation of the yield of butter from milk, E. SAILLARD (*Jour. Agr. Prat., 61 (1897), I, No. 3, pp. 93–95*).

The production and exportation of butter in Finland, G. GROTENFELT (*Landbruket i Finnland; extract in Milch Ztg., 25 (1896), No. 46, p. 732*).—The history of the development of butter making is reviewed. In the middle of the present century about one-half million kilograms (over 1,000,000 lbs.) of butter was exported, all of which was made by the peasants. The amount made on large estates subsequently increased, and finally in about 1880 creameries were established by the peasants. In 1895, 14,115,054 kg. (over 31 million lbs.) was exported.

Statistics of the creameries of Mecklenburg-Schwerin for the year 1895, J. SIEDEL (*Milch Ztg., 26 (1896), No. 49, p. 779*).

Character and extent of investigation relating to the manufacture of cheese during the season of 1894, L. L. VAN SLYKE (*New York State Sta. Rpt. 1894, pp. 452–522*).—A reprint of Bulletin 82 of the station (E. S. R., 7, p. 158).

AGRICULTURAL ENGINEERING.

American highways, N. S. SHALER (*New York: The Century Co., 1896, pp. 293, figs. 16, pls. 11*).—In his preface the author states that this work is not intended to constitute a complete treatise on road making from the professional engineer's standpoint, because such works are already numerous; but it was prepared with a view to its serving as a guide "for those who wish to understand the general aspects of the highway problem, or who would learn what kind of road may be contrived to meet the needs of the various surroundings, natural and artificial, in which our people find themselves."

The author's experience as one of the three members of the Massachusetts Highway Commission is largely drawn upon in the preparation of the book. It is believed that an examination of it will show that it attains the object sought in a very satisfactory manner, and covers very completely a portion of the field of road making which has heretofore been neglected. The scope of the work is indicated by the chapter headings: General history of road building, early American roads, effect of climate, nature and distribution of road materials and the methods of use, methods of testing road materials, the governmental relations of roads, the relation of public ways to the ornamentation of a country, methods of constructing roads, methods of administration of roads, machines used in road making, the cost of road building—sidewalks—parapets—city streets, on education in the science and art of road building, and summary and conclusion. Appendices give the Massachusetts laws relating to road building; laboratory tests of road-building stones; contract prices on Massachusetts State roads, 1894–'95, and a list of important works on highway construction.

Draft of harrows, C. W. MCCULLOUGH (*Agl. Student, 3 (1896), No. 3, pp. 74, 75*).

Combined weed-seed separator and grading machine Universal (*Deut. landw. Presse, 23 (1896), No. 78, p. 702, fig. 1*).—The chaff, dust, and lighter portions are first

separated by a blast of air, then the grain falls through inclined cylindrical sieves, by which the weed seed is removed and the remaining grain graded.

Irrigation in Italy and Spain, A. VON HORN (*Jour. Landw., 44 (1896), No. 3, pp. 235–254.*)—A discussion of the extent and importance of irrigation works in these countries, especially from the economic standpoint.

The irrigation system of the town of Rheims, A. VON HORN (*Jour. Landw., 44 (1896), No. 4, pp. 333–336, fig. 1*).—The system of sewage disposal is described.

The injurious effects of the sewage from different manufactories, J. KÖNIG (*Landw. Vers. Stat. Münster, Eine Denkschrift, 1896, pp. 152–191*).—Accounts are given of investigations since the organization of the station of the injurious effects on soils, plants, and domestic animals, including fish, of salt (NaCl), calcium chlorid, magnesium chlorid, and barium chlorid solutions, zinc sulphate and iron sulphate solutions, copper sulphate and nitrate solutions, and nickel and cobalt solutions; with a chapter on the composition and purification of town sewage, including sewage from rice starch, wheat starch, sugar, straw paper, color, gelatin and bone meal, ammonia, and yeast factories, and from creameries, tanneries, distilleries, fulleries, and electric works.

Trials of potato-raising machines at Leicester, J. MCCONNELL (*Jour. Roy. Agr. Soc. England, ser. 3, 7 (1896), No. 28, pp. 700–704*).

Suggestions on the building and equipment of creameries, F. B. LINFIELD (*Utah Sta. Bul. 43, pp. 60–64*).—Popular suggestions on these points.

Building creameries and organization of coöperative creamery companies, J. M. TRUEMAN (*South Dakota Sta. Bul. 46, pp. 18, figs. 2*).—Articles of incorporation and by-laws of a creamery, together with plans and equipment for a creamery building.

Modern farm buildings: Their construction and arrangement, A. D. CLARKE (*2d ed. London: B. T. Batsford, 1895, pp. 148; reviewed in Jour. Roy. Agr. Soc. England, ser. 3, 7 (1896), No. 28, pp. 780–783*).

STATISTICS.

Reports of treasurer and of director of New York State Station, 1894 (*New York State Sta. Rpt. 1894, pp. 1–8, 136, 137, 170–179*).—Treasurer's report for the fiscal year ending September 30, 1894, brief outline of the work of the year, new legislation affecting the station, and list of gifts made to the station.

Reports of the director and treasurer of Rhode Island Station, 1895 (*Rhode Island Sta. Rpt. 1895, pp. 173–192, 366–372*).—A comprehensive account of work at the station, list of exchanges and donations, and financial statement for the fiscal year ending June 30, 1895.

Eighth Annual Report of South Carolina Station, 1895 (*South Carolina Sta. Rpt. 1895, pp. 47–72*).—Brief reports are given by the secretary of the board of fertilizer control, director, agriculturist, horticulturist, dairyman, and chemist, some work done by the dairyman and chemist being reported elsewhere. A financial statement is made for the fiscal year ending June 30, 1895.

Sixth Annual Report of Utah Station, 1895 (*Utah Sta. Rpt. 1895, pp. 40–45*).—This includes a financial statement for the fiscal year ending June 30, 1895, and abstracts of the bulletins issued.

Index to Wyoming Station Bulletins (*Wyoming Sta. Index Bul. A, pp. 15*).—List of the first 26 bulletins of the station and index to contents.

The status of the Rothamsted experiments in 1894, K. BIELER (*Landw. Jahrb., 25 (1896), No. 2–3, pp. 195–360, figs. 2*).—This admirable account is based on a visit made to the Rothamsted Station by the author in the summer of 1894 and a study of the numerous publications of the station. A historical sketch and description is given of the station, followed by a detailed account of the experiments in progress in 1894. In discussing the latter, the results in these lines in previous years are

briefly given. Hence the account of the work covers, in a general way, the field covered by Sir Henry Gilbert in his Agricultural Investigations at Rothamsted, England, during a period of Fifty Years, published as Bulletin 22 of this Office in 1895.

Course of wheat production and exportation in the United States, Canada, Argentina, Uruguay, Russia, and British India from 1880 to 1896 (*U. S. Dept. of Agr., Section Foreign Markets Circ. 10, pp. 8*).—Tables are given showing the yearly and the average annual production of wheat and exports of wheat and flour for these countries for the periods 1881–1885, 1886–1890, and 1891–1895.

The cotton crop of 1895 (*U. S. Dept. Agr., Division of Statistics Circ. 4, pp. 8*).—Full statistics are given of the production and movement of the cotton crop of 1895 by States.

The world's market for American products, Sweden (*U. S. Dept. Agr., Section Foreign Markets Bul. 8, pp. 92*).—General discussion of natural and economic conditions of the country, with tables relating to principal industries, tariff regulations, and foreign trade. Lists are given of the consular representatives of the United States in Sweden and of Sweden in the United States, and reports from the consular representatives at Stockholm, Gothenburg, and Malmö.

Bukowinaer landwirtschaftliche Blätter.—A new journal in German, Russian, and Ruthenian, published by E. Baier and N. Wender, in Czernowitz.

NOTES.

IDAHO STATION.—President F. B. Gault, of the University of Idaho, has been made director of the station, *vice* C. P. Fox, who retains his position as agriculturist.

KANSAS STATION.—Isaac Jones has been made assistant in horticulture in place of F. C. Sears, who has resigned to accept a professorship in the Utah Agricultural College. H. Kelley, of Burlington, and Mrs. J. P. St. John, of Olathe, have become members of the board of regents in place of S. J. Stewart and C. G. Bulkley.

MASSACHUSETTS STATION.—The chemical building of the station has been improved by a one-story addition, 29 by 55 ft., which connects the two wings of the old building, and with them incloses a court 31 by 175 ft. This court has been floored and covered with a glass roof, and will be used as a collection room. The addition will furnish two laboratory rooms, each containing 610 square feet. A new elevator, ventilating flues, and other improvements will greatly facilitate the laboratory work.

MICHIGAN COLLEGE AND STATION.—R. H. Pettit, formerly assistant to the State entomologist at the Minnesota Station, has accepted the position of assistant in entomology of this college and station.

MINNESOTA COLLEGE AND STATION.—W. M. Liggett, who for several years has been chairman of the agricultural committee of the board of regents and of the experiment station corps, has been elected dean of the department of agriculture and director of the experiment station. Owing to free transportation furnished by several of the Minnesota railroads, about 3,000 farmers have been able to visit the experiment station and school of agriculture.

SOUTH DAKOTA STATION.—L. P. Sweezy, of Vermilion, has been appointed member of the board of regents in place of J. W. Sheldon.

TEXAS COLLEGE AND STATION.—J. W. Carson has resigned his position as foreman of farm and assistant director, to take effect January 1, and H. C. Kyle has been appointed to succeed him, the title being changed to foreman of college and station farm.

WYOMING STATION.—At a meeting of the board of trustees on December 17, the substations at Saratoga, Sundance, and Wheatland, were not provided for in the appropriations for the next six months. Small appropriations were made for the substations at Lander and Sheridan.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vols. I to VII, with indexes; Vol. VIII, Nos. 1-8.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of Stations and Colleges, 1892; No. 13, Organization Lists of Stations and Colleges, 1893; No. 14, Proceedings of Convention of National League for Good Roads, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of Stations and Colleges, 1894; No. 20, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of Stations and Colleges, 1895; No. 24, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of Stations and Colleges, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University in 1895; No. 33; The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses; No. 34, The Carbohydrates of Wheat, Maize, Flour and Bread, and the Action of Enzymic Ferments upon Starches of Different Origin; No. 35, Food and Nutrition Investigations in New Jersey in 1895 and 1896; No. 36, Notes on Irrigation in Connecticut and New Jersey; No. 37, Dietary Studies at the Maine State College in 1895; No. 38, Dietary Studies with Reference to the Food of the Negro in Alabama in 1895 and 1896; No. 39, Organization Lists of Stations and Colleges, 1897; No. 40, Dietary Studies in New Mexico in 1895.

Miscellaneous Bulletins.—Nos. 1, 2, and 3, Proceedings of Association of Agricultural Colleges and Experiment Stations, January and November, 1889, and November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates; No. 49, Sheep Feeding.

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beattie

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
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With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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EXPERIMENT STATION RECORD.

Vol. VIII. No. 8.

It has been recognized for a number of years that the nitrogen-free extract of feeding stuffs contains a variety of carbohydrates of widely different chemical composition and properties and of different rates of digestibility. This fact taken in connection with the uncertain manner of determining this indefinite and variable group has created a distrust of the value of such determinations, and has made it very apparent that a more radical treatment of this important group of nutrients is called for by the present status of knowledge. Reference has been made to the recognition of this by the Association of Official Agricultural Chemists and their determination to confine their studies on methods of fodder analysis to the perfection of methods for determining more definite groups of constituents.

The interest in this phase of agricultural analysis and nutrition has become more and more widespread with the progress of investigation, and as this research has, for the most part, been confined to comparatively few investigators and those largely in other countries, a concise, systematic discussion of the nitrogen-free extract, its constituents, their determination, nutritive value, etc., and its relation to other groups of constituents, has seemed desirable. Such a résumé by the leading spirit in these investigations is presented in this number of the Record. Professor Tollens has a world-wide reputation for his research on the carbohydrates occurring in nature, and has given close study to this group of constituents in their relation to methods of analysis and to feeding. It is believed that the bringing together of the information on this subject from various sources and the treatment of it in its relations to the methods of analysis and research in nutrition will be helpful to all, and especially to those who have not followed the literature systematically.

In his paper Professor Tollens points out the deficiencies and the advantages of the Weende method, and gives a somewhat historical account of its development. One point which he makes very plain is that Professor Henneberg, the originator of the method, understood and recognized its weaknesses quite as well as those who have since criticised it freely. Furthermore, Professor Henneberg urged caution

against making a too wide application of the method devised for fodder analysis, and recommended the determination of smaller and more definite groups of substances.

Professor Tollens recommends that the Weende method be continued in use until a better method is elaborated, supplementing it by determinations of the aqueous extract of the pentosans. He points out that the determination of aqueous extract, which is very simple, would add considerable approximate information which would be of value in judging of feeding stuffs. For instance, he shows that the aqueous extract corresponds approximately to the digestible nitrogen-free extract, and that the sum of the digested crude fiber and the digested nitrogen free extract agrees fairly well with the total nitrogen-free extract; hence the difference between the total nitrogen-free extract and the aqueous extract is approximately equivalent to the digestible cellulose. Where more explicit information is desired as to the various constituents of the nitrogen-free extract, he recommends that the sugars, starch, organic acids, etc., be determined by the customary methods.

It is gratifying to note that two methods for determining the different constituents of this indefinite group of constituents have recently been described by chemists in this country. A method by W. E. Stone, noted elsewhere, enables the determination in the same sample by a proper sequence of the sucrose, invert sugar, dextrin, soluble starch, normal starch, pentosans, and crude fiber. With this method, somewhat modified by use, some determinations have been made of the various carbohydrates of wheat, flour, corn, and bread made from the same. Another method, recently described by H. C. Sherman, separates the carbohydrates in a similar manner into soluble carbohydrates, starch, free pentosans, lignin and allied substances, and cellulose.

Neither of these methods has been tested to any considerable extent, and possibly neither of them will be found to entirely answer the purpose when subjected to a practical test; but if they serve to stimulate attempts to apply the results of recent investigation to the more rational analysis of feeding stuffs, they will have served an excellent purpose. They open up the way for investigations of this character at the experiment stations, not only in testing and improving the methods, but in making practical application of them in feeding experiments on the digestibility and the nutritive value of feeding stuffs—*i. e.*, in determining the nutritive value and functions, not of an indefinite and varying mixture like the nitrogen-free extract, but rather of such definite and widely distributed groups as sugars, starch, pentosans, cellulose, etc. This is highly important if progress is to be made in studying the fundamental problems of nutrition. Subsequent investigations may enable the combining of certain of these groups, but for the present a larger number of more definite groups of ingredients should be taken into account.

THE NITROGEN-FREE EXTRACT OF PLANTS AND FEEDING STUFFS.

B. Tollens, Ph. D.

Director of the Agricultural-Chemical Laboratory of the University of Göttingen, Germany.

For many years past the so-called Weende method has been commonly used in the experiment stations in Germany and America for determining the composition of feeding stuffs, and for judging of their value for animal nutrition. The method was devised by the late Prof. W. Henneberg, director of the experiment station at Göttingen, Germany, formerly located at Weende, near Göttingen. By means of it Professor Henneberg showed the fallacy of Thaer's hay-value theory of feeding stuffs, according to which the value of a feeding stuff was stated in terms of 100 lbs. of meadow hay.

As is well known, in this method the percentages of the ash, protein, fat, and crude fiber are determined by fixed analytical methods, and the sum of these and the water, subtracted from 100, gives the so-called nitrogen-free extract.

As the name implies, Henneberg did not regard this nitrogen-free extract as a distinct, uniform substance, but rather as a mixture.

It represents that portion of a feeding stuff which is not soluble in ether (fat),[1] and does not belong to the nitrogenous (protein) or ash constituents, but is dissolved by the reagents used in determining crude fiber, especially by the dilute boiling acid and alkali. The nitrogen-free extract is, therefore, the portion of a feeding stuff soluble in this dilute acid and alkali, less the fat, protein, and ash. It is evident that it would include the water-soluble substances, especially the sugars and other soluble carbohydrates, such as gums, inulin, etc. Many other carbohydrates are dissolved in boiling dilute acid, notably starch, mucilages, etc.; and boiling with dilute potassium hydroxid completes the action.

CONSTITUENTS OF THE NITROGEN-FREE EXTRACT.

The carbohydrates always constitute a large part of the nitrogen-free extract, and this fact has led some chemists to designate it as

[1] Besides the true fats, *i. e.*, the glycerids of the fatty acids, this crude fat contains a variety of other substances, for an account of which see E. Schulze, Landw. Vers. Stat., 15 (1872), p. 81; and J. König, Landw. Vers. Stat., 13 (1870), p. 241.

"carbohydrates" instead of by the longer and less definite term of "nitrogen-free extract." This, however, is not warranted, since the nitrogen-free extract necessarily includes various materials which, like the carbohydrates, possess the qualities of solubility in water, dilute acid, and dilute alkali, and which are neither carbohydrates, fat, protein, nor ash. All known carbohydrates found in nature may occur in the nitrogen-free extract,[1] consequently a brief résumé of the principal groups of carbohydrates may be helpful in considering its nature.

HEXOSES AND THEIR DERIVATIVES.[2]

The hexoses have the general composition $C_6H_{12}O_6$. Their derivatives are cane sugar ($C_{12}H_{22}O_{11}$), hexosans ($C_6H_{10}O_5$), etc.

The various hexoses (monosaccharids, $C_6H_{12}O_6$).—(1) *Dextrose* (or glucose) occurs in sweet fruits, like grapes, strawberries, raspberries, gooseberries, apples, cherries, plums, etc., in larger or smaller quantities, up to 15 or 20 per cent, and is always associated with levulose or cane sugar. Dextrose and levulose are sometimes present in equal molecules, but usually the one or the other sugar predominates, as in the case of grape juice and apple juice, according to Kulisch and Berend. Dextrose is found in small quantities in the leaves of various plants, in the stems of cereals, in maize, sorghum, sugar cane (together with cane sugar), malt, roots and tubers (potato), and in many other parts of plants.

(2) *Levulose* nearly always occurs with dextrose, and sometimes in considerable quantities. Levulose and dextrose may be formed simultaneously in leaves from the carbon dioxid of the air, or they may be produced from cane sugar by hydrolysis, the mixture being known in that case as invert sugar. In all probability the sugars in the leaves of plants are produced by the action of light, with the aid of the chlorophyll of green leaves, from the carbon dioxid of the air; oxygen is liberated, and by the simultaneous action of water formic aldehyde (CH_2O) is produced, which is polymerized to $C_6H_{12}O_6$ or other carbohydrates.

(3) *Mannose* as such has not been recognized with certainty in vegetable materials, although its mother substances, mannan and paramannan, occur frequently.

(4) *Galactose* seems also not to occur in nature as such. It is easily produced from galactan and paragalactan, which are of common occurrence.

(5) *Sorbose* has not been recognized as such in unchanged vegetable materials.

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[1] A comprehensive, concise treatise on the carbohydrates with very full bibliography is given in B. Tollens' Kurzes Handbuch der Kohlenhydrate, vols. 1 and 2, Breslau, 1888 and 1895, to which the reader is referred.

[2] The writer uses "derivative" in this article in its physiological instead of its analytical sense. That is, starch is regarded as a physiological derivative of hexose, produced in the plant by the polymerizing of hexose with the elimination of water.—Ed.

Cane sugar and other di- and tri-saccharids—(1) *Cane sugar* ($C_{12}H_{22}O_{11}$) is very common in nature, and appears to be found in larger or smaller quantities almost wherever it is looked for in vegetable substances. It occurs in leaves of trees, grass, hay, beet tops; in the blossoms of clover and other plants; in the stalks of cereals, maize, sorghum, and especially sugar cane; and in the trunks of some trees, as the maple, birch, and various palms. It is also a constituent of the seeds of various cereals, maize, soja bean, and the cocoa palm, and of nuts. It occurs in sweet fruits, accompanied by dextrose and levulose, the amount apparently increasing as the acid in the fruit decreases. Figs, dates, bananas, and melons, for instance, contain considerable quantities of cane sugar. It is found in roots and tubers, a notable example being the sugar beet, but it is also found in unripe and frozen potatoes, in sweet potatoes, cassava tubers, etc.

(2) *Trehalose* (or mycose, $C_{12}H_{22}O_{11}+2H_2O$) is isolated from trehala manna in large quantities. It is also present in various fungi and in ergot.

(3) *Raffinose* ($C_{18}H_{32}O_{16}+5H_2O$) occurs to the extent of about 3 per cent in cotton seed, also in smaller amount in the sugar beet, the sprouts of germinated wheat, and perhaps elsewhere.

(4) *Stachyose* ($C_{18}H_{32}O_{16}-3H_2O$) is a constituent of the tubers of *Stachys tuberifera.*

Some other substances belonging to this group are, for instance, gentianose in the gentian root, lactosin in Silene species, and maltose, which possibly occurs with starch in the cereals, rice, etc.

Polysaccharids derived[1] *from hexoses and hence called hexosans.*—(1) *Starch*, $n(C_6H_{10}O_5)$,[2] frequently comprises the larger part of the nitrogen-free extract. It occurs in the cereals in large quantities. For instance, maize, barley, wheat, and rye contain from 60 to 70 per cent; oats nearly 55 per cent; and rice nearly 75 per cent of starch. Peas and beans contain about 50 per cent. The potato has from 17 to 24 per cent of starch, and many other fleshy tubers and roots have a large starch content. Large quantities of starch are also stored up in the pith of certain trees, as the sago palm. Starch occurs in small quantities nearly everywhere in the vegetable kingdom, and this general occurrence is easily understood, since starch is produced in the leaves (probably from the glucose first formed) and from these is transported to the reserve cells in the seeds, roots, etc.

(2) *Glucose-yielding substances accompanying starch*, as glycogen, dextrin, dextran, etc. Many fungi, glutinous rice from Japan, etc., contain gummy amorphous substances, which when heated with dilute acid invert to dextrose, and which are closely allied to the dextrin obtained from starch. The substances known as paradextran, pachymose, etc., belong with this group of bodies.

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[1] See second footnote on opposite page.

[2] The value of "n" is stated by different authors at all the way from 4 to 200.

(3) *Inulin*, $n(C_6H_{10}O_5)$,[1] plays a similar rôle in the Compositæ to starch in most other plants. It is not stored up in grains like starch, but occurs in solution. By immersing parts of the plant in alcohol the inulin is changed to a crystalline state. Inulin further differs from starch in yielding levulose by hydrolysis with dilute acids instead of dextrose.

There is also a class of substances accompanying inulin and yielding levulose, to which belong a series of gummy materials precipitated by alcohol and of nearly the same composition as inulin, which occur with the latter in the tubers of *Helianthus tuberosus*. These are levulin and synanthrose, which, according to recent investigations by Tanret, are produced from pseudo-inulin, inulenin, helianthenin, and synanthrin. To this group belong also a large number of substances from various plants, partly Compositæ, all of which are amorphous, levorotatory, and the larger part of which at least yield levulose on hydrolysis. Among these may be mentioned levosin, triticin, irisin, sinistrin, scillin, phlein, graminin, etc.

(4) *Mannose-yielding substances or mannans.*—According to the investigations of Reiss and of E. Fischer, many seeds with a hard endosperm composed of thick-walled cells contain an amorphous substance which, on heating with dilute acids, yields mannose. This substance, was first isolated by Reiss and was named seminin. It is at present called mannan, or when it is insoluble in water and in dilute potassium hydroxid, paramannan. The latter (paramannan) occurs in the hard seeds of dates, the coffee bean, *Strychnos nux-vomica*, etc., and especially in vegetable ivory. More soluble mannan is contained in the roots of salep and in several Japanese plants. Wood also contains some mannan.

(5) *Galactose-yielding substances or galactans* are gum-like substances, occurring especially in leguminous plants, and yielding galactose by hydrolysis and by oxidation with nitric acid the same product as galactose, *i. e.*, mucic acid. These galactans are in part soluble in water and very dilute potassium hydroxid, and in part insoluble in the latter. The soluble substances are designated α, β, and δ-galactan, and the insoluble substances, paragalactans. Müntz, and E. Schulze, Steiger and Maxwell have studied the different galactans in lupine seed, peas, beans, etc., and named one of the soluble galactans in lupine, lupeose. Other chemists have isolated galactans from agar-agar, etc.

(6) *Mucilages and gums.*—Pectin substances occur to considerable extent in plants, for example, in the beet, berries of different kinds, flaxseed, etc. They gelatinize with water, giving a thick and sometimes stringy or slimy solution, and on inversion with dilute mineral acids yield the different glucoses described above and also pentoses (see below). For the most part they are carbohydrates, and they all belong to the nitrogen-free extract.

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[1] The inulin molecule appears not to be as large as that of starch, and the value of "n" has recently been stated at 12 and 18.

MONOSACCHARIDS OF OTHER COMPOSITIONS AND THEIR DERIVATIVES.

Aside from the hexoses enumerated and the substances which yield hexoses (dextrose, mannose, galactose, levulose) by hydrolysis, the nitrogen-free extract may contain derivatives of theoretical hexoses,[1] and of monosaccharids of other series, notably of the pentoses ($C_5H_{10}O_5$), and probably also those of the tetroses ($C_4H_8O_4$), the heptoses ($C_7H_{14}O_7$), etc., although none of the latter have as yet been found in plants. The derivatives of these special (theoretical) monosaccharids occurring in plants contain less water than the hexoses, and are derived from the latter by the loss of one molecule of water. Their names are formed by adding the syllable *an* to the name of the monosaccharid, as $C_4H_6O_3$ tetrosan, $C_5H_8O_4$ pentosan, $C_7H_{12}O_6$ heptosan, etc.

Pentoses and pentosans.—The pentoses are sugars having the formula $C_5H_{10}O_5$, from which they derive their name. Their derivatives, which are formed from them in the same way that starch is from glucose, *i. e.*, by the loss of water, are the pentosans, $C_5H_8O_4$.

According to E. Fischer's comprehensive theory, there are 8 pentoses.[2] Of these, 2 have as yet been found in nature, namely, arabinose and xylose (wood sugar). These 2 sugars are not known to occur as such, but as pentosans, namely, as araban and xylan (wood gum).

Arabinose, discovered by Scheibler, is prepared from gum arabic, cherry gum, beet pith, and other substances which contain araban, by treating these materials with dilute sulphuric acid and thus hydrolyzing the araban to arabinose.[3] Xylose, discovered by Koch and further investigated by Wheeler, Allen, and Tollens,[4] is obtained from substances which contain xylan (wood gum), as for example, wood and straw. It is most easily obtained from wood by extracting the xylan with sodium hydroxid and then hydrolyzing this with acid.

Formerly the pentoses were not distinguished from common sugars or hexoses, because they are very similar to these, and more especially because, like these, they reduce Fehling's solution. Since the above-mentioned investigations on xylose the pentoses have been industriously searched for, and especially since Stone and Tollens demonstrated that the formation of furfurol from the pentoses and pentosans by distilling with acid is a characteristic reaction for these substances. Besides this reaction there are others equally characteristic, namely, the red coloration when pentoses or pentosans are heated with hydrochloric acid and phloroglucin, and the constant spectral absorption of this solution.[5] These reactions enable the detection of very small amounts of pentoses, and are taken advantage of in their quantitive determination.[6]

[1] See reference to E. Fischer's investigations in Tollens' Kurzes Handbuch der Kohlenhydrate, vol. 2, p. 14.

[2] Tollens' Kurzes Handbuch der Kohlenhydrate, vol. 2, p. 21.

[3] Stone and Tollens, Liebig's Ann. Chem., 249 (1888), pp. 238, 267.

[4] Liebig's Ann. Chem., 254 (1889), p. 316.

[5] Wheeler, Allen, and Tollens, Liebig's Ann. Chem., 254 (1889), pp. 260, 289, 304.

[6] Investigations of Stone, de Chalmot, Flint, Mann, and Krüger, all of which except some recent work by Stone and de Chalmot were carried on under the direction of the writer.

The quantitative determination of the pentoses is accomplished by distilling the material containing pentosan with hydrochloric acid of known strength, whereby furfurol ($C_5H_4O_2$) is generated from the pentoses which are first formed, with the elimination of water. This furfurol is changed to an insoluble form in which it can be weighed by the addition of phenylhydrazin,[1] or better, as the investigations of Krüger and Tollens have shown, by phloroglucin.[2]

It has been found that most vegetable materials, after they have passed the first stage of growth, and as soon as traces of lignification appear, invariably contain pentosan. This pentosan is partially dissolved by boiling with dilute sulphuric acid, and thus increases the amount of the nitrogen-free extract.[3]

Whether monosaccharids of other composition or their mother substances, as tetrosan, heptosan, etc., occur in vegetable substances, is at present not known. Furthermore, we have no positive information as to whether the substances which yield furfurol on distillation are always really arabinose or xylose, or whether, as Cross and Bevan[4] believe, other substances (furfuroses or furfurosans) yield a part of the furfurol.

Rhamnose ($C_6H_{12}O_5 + H_2O$) *and rhamnosan.*—In some materials as *Rubia tinctorum*, buckthorn berries, and possibly oranges, a part of the sugar may be rhamnose. There may also be a derivative of rhamnose, rhamnosan.

NONCARBOHYDRATE CONSTITUENTS OF THE NITROGEN-FREE EXTRACT.

Organic acids.—Among the substances dissolved by the reagents of the Weende method may be organic acids, such as oxalic, succinic, malic, citric, acetic, glycollic, and lactic acids, in the form of salts soluble in water, acids, and alkalies.

Higher alcohols.—Other constituents of the nitrogen-free extract are higher alcohols, which, although closely related to the carbohydrates, do not always possess exactly their composition. These are mannit, dulcit, sorbit, inosit, perseit, etc. Some of these occur commonly. Beans, for instance, contain inosit.

Lignin substances.—By the term "lignin" or "incrusting substances" is commonly understood those substances not cellulose or xylan (wood gum, pentosan) which are deposited in and upon the lignified cell walls. The Weende method separates these substances for the most part with the crude fiber, but a certain amount may be dissolved by the reagents used and so fall in the nitrogen-free extract.

As a result of analyses of crude fiber rich in lignin Henneberg, and also Dietrich and König,[5] concluded that lignin was rich in carbon,

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[1] Lindsey and Holland, Mass. State Sta. Rpt. 1894, p. 177.

[2] Ztschr. angew. Chem., 1896, pp. 33, 194.

[3] A résumé of the work thus far done on the pentoses and pentosans is given in Jour. Landw., 44 (1896), p. 171 (E. S. R., 8, p. 281).

[4] Chem. News, 70 (1894), p. 296.

[5] Landw. Vers. Stat., 13 (1870), p. 222; 16 (1873), p. 419.

containing approximately 55 per cent. In later years Lindsey, Street, and Tollens[1] arrived at the same conclusion as to the richness of lignin in carbon from investigations on the lignin substances dissolved from wood manufacture of cellulose for paper making. In the course of this process of manufacture the lignin substances are dissolved by the sulphurous acid or soda, as sulphonic acids, and probably have the approximate composition $C_{26}H_3O_9$ (Lindsey and Tollens), or $C_{36}H_{42}O_{13}$ (Street and Tollens), with several molecules of water added.

The formulas found by Lindsey, Street, and Tollens call for 63.3 to 64.2 per cent of carbon and 6.2 per cent of hydrogen, and in this respect are in accord with the composition of lignin as given by Bertrand[2] which calls for 61.8 per cent of carbon, 5.8 per cent of hydrogen, and 1.5 per cent of nitrogen (according to which lignin is a nitrogenous material).

Other substances of various kinds.—There are still other substances which are not determined as fat, protein, crude fiber, or ash, and consequently fall under the head of nitrogen-free extract. These are largely aromatic substances—tannic acid especially—which belong to the coloring matters, alkaloids, etc., whose nature as well as feeding value is difficult to define.

MIXED NATURE OF THE NITROGEN-FREE EXTRACT.

The material grouped under the name of nitrogen-free extract is accordingly a very complex mixture in which carbohydrates predominate, but in which many other substances occur.

It can be easily proved that nitrogen-free extract contains other substances besides carbohydrates by determining the separate carbohydrates by ordinary methods. If this is done the total amount of carbohydrates may sometimes be approximately equal to the nitrogen-free extract, but there is more apt to be a deficiency. For instance, Washburn and Tollens[3] obtained the following results with samples of sweet corn in different stages of ripening:

Total carbohydrates and nitrogen-free extract in sweet corn.

	Ripe.	Less mature.		Very young.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Nitrogen-free extract by Weende method (by difference)	72.91	72.51	70.80	57.52
Total carbohydrates, determined directly	67.94	63.69	60.35	37.12
Difference	4.97	8.82	10.45	20.40

Similar results were obtained by Atwater.[4] Less significant but noteworthy results were obtained by Krauch. He digested various

[1] Liebig's Ann. Chem., 267 (1892), p. 341; Street, Inaug. Diss. Göttingen, 1892.

[2] Bul. Soc. Chim. Paris, ser. 2, 7, p. 469.

[3] Liebig's Ann. Chem., 257 (1890), p. 156; Jour. Landw., 37 (1889), p. 503.

[4] Amer. Jour. Sci., 48 (1869), p. 352.

materials with 1.25 per cent sulphuric acid and determined the portion which had been dissolved and the resulting sugar (probably with Fehling's solution). He heated the residue from this digestion with 1.25 per cent potassium hydroxid and likewise determined the portion dissolved (no sugar could be recognized in this solution). The results are given in the following table:

Amounts dissolved by dilute acid and alkali, and sugar in the resulting solutions.

	Rye.	Meadow hay.	Crimson clover.
	Per cent.	*Per cent.*	*Per cent.*
Dissolved by 1.25 per cent sulphuric acid	48.12	28.39	19.44
Dissolved by 1.25 per cent potassium hydroxid	34.57	24.65	31.84
Total dissolved	82.69	53.04	51.28
Sugar resulting from digestion with:			
1.25 per cent sulphuric acid	19.21	8.33	1.84
1.25 per cent potassium hydroxid [a]	None.	None.	None.

[a] It is not surprising that no sugar could be found in the 34.57 per cent of material dissolved by the 1.25 per cent potassium hydroxid, since weak potash solution does not invert "condensed" carbohydrates, and for the most part so changes any hexoses present or formed that they do not react upon Fehling's solution at all or only weakly.

Hence only a small proportion of the substance dissolved from the above materials by 1.25 per cent of sulphuric acid was recovered in the form of sugar. Even allowing that the dissolved portion of "condensed" carbohydrates was only incompletely hydrolyzed to hexoses by the weak sulphuric acid, the difference between the 48.12 per cent of substance dissolved from rye, for instance, and the 19.21 per cent of sugar found in the solution is very large.

These observations give rise to great uncertainty, but show conclusively that the percentages of nitrogen-free extract found by the Weende method represent not only the soluble carbohydrates of feeding stuffs, but many other substances as well.

OTHER UNCERTAINTIES AS TO THE FIGURES FOR NITROGEN-FREE EXTRACT.

Since the nitrogen-free extract is determined by difference, it is evident that all the errors in the determination of the other constituents are accumulated in the nitrogen-free extract. Of the substances determined directly, the ash is in general the least open to objection. Little objection can be made either to the determination of fat or crude fat, although the material extracted with ether is at times of quite a mixed nature.[1]

More objection can be made to the protein calculated from the nitrogen by the factor 6.25, which assumes that the protein substances contain 16 per cent of nitrogen. While this assumption holds good in case of some proteids, it does not in case of others. The proteids of

[1] Regarding the nature of the crude fat, see, among others, E. Schulze, Landw. Vers. Stat., 15 (1872), p. 81; König, Landw. Vers. Stat., 13 (1870), p. 241.

leguminous plants (legumin and conglutin) contain, according to Ritthausen, 17 to 18 per cent of nitrogen, and some globulins contain nearly 19 per cent. On the other hand, some of the proteids of milk are found to have only 15 per cent of nitrogen; and other nitrogenous substances, as amids, etc., have still other nitrogen contents.[1] Hence, by using the average factor 6.25 a greater or less error in the protein content will sometimes be involved, which is naturally reflected in the nitrogen-free extract. But the various uncertainties in connection with the determination of crude fiber are of much greater influence on the amount of nitrogen-free extract, as will be seen below.

UNCERTAINTIES IN THE DETERMINATION OF CRUDE FIBER.

The fact that the crude fiber is not wholly insoluble in the reagents used in the Weende method is a disturbing element in the determination of nitrogen-free extract by difference. If some of the crude fiber is dissolved by the dilute acid and alkali the nitrogen-free extract will be too high; and, on the other hand, if the crude fiber is not sufficiently pure the nitrogen-free extract will be too low.

In this connection, the questions arise, What is crude fiber, and upon what is its determination based?

Henneberg designated as crude fiber the residue remaining after treating the feeding stuff with 1.25 per cent sulphuric acid, water, 1.25 per cent potassium hydroxid, water, alcohol and ether, and which consisted principally of the cellulose of the plant. He stated[2] that this name was preferable to woody fiber (cellulose), and furthermore that crude fiber was of a mixed nature.

Besides true cellulose, crude fiber contains some of the lignin substances which are entirely different from cellulose in their physiological action. These substances sometimes remain almost completely intact during the boiling with acid and alkali, but sometimes they are more or less dissolved. This will naturally depend primarily on the exact method of analysis employed; and as Henneberg's original method has been variously modified from time to time, it will be of interest to notice some of the original communications on the method.

The methods of crude fiber determination.—Henneberg[3] gives the following directions for his methods: About 3 gm. of the well-ground substance is boiled for one-half hour in a porcelain dish with a mixture of 50 cc. of 5 per cent sulphuric acid and 150 cc. of water, the volume being kept constant by the addition of water as it evaporates. In order to keep the volume constant at 200 cc., it was recommended, as a result of the investigations of Wattenberg,[4] carried on in Henneberg's

[1] Concerning this question, see a recent article by Ritthausen in Landw. Vers. Stat., 47 (1896), p. 391 (E. S. R., 8, p. 279).

[2] Weender Beiträge, vol. 2, p. 49.

[3] Henneberg and Stohmann, Weender Beiträge, vol. 2, p. 48.

[4] Jour. Landw., 28 (1880), p. 273.

laboratory, to use a dish with a blue ring on the inside at the 200 cc. point. After boiling, the solution is allowed to settle and the clear liquid removed, according to Henneberg and Stohmann, with a small siphon or, according to Wattenberg, by means of a funnel covered with gauze over which filter paper is placed, the funnel being inverted in the liquid and the stem connected with a suction pump or a siphon. The residue is boiled for one-half hour with 200 cc. of water, and the water removed as before, and this boiling with water is repeated. (Where the suction filter is used, Wattenberg states that it is not necessary to bring the water to boiling the second time, but that it can be siphoned off immediately.)

A mixture of 50 cc. of 5 per cent potassium hydroxid and 150 cc. of water—*i. e.*, a 1.25 per cent solution—is now added to the residue, boiled for one-half hour, drawn off as before, and the residue boiled twice with water, as described above.

The residue is then collected on a tared filter previously dried at 105° C., washed with hot water until the alkaline reaction disappears, several times with hot alcohol and with ether, dried at 105°, and weighed.

The crude fiber obtained in this way contains a little inorganic matter, and usually some nitrogen. Accordingly, it is incinerated and the ash deducted; and in very exact determinations the nitrogen must also be determined, multiplied by 6.25, and the protein deducted.

Holdefleiss[1] proposed to carry on the digestion with acid and alkali in pear-shaped bulbs of about 300 cc. capacity, the boiling being effected by conducting steam into the bulbs. At the end of the treatment the bulbs are dried with the residue at 100 to 105° C., weighed, and the crude fiber incinerated in a crucible, and the ash weighed and deducted. To simplify the drying of the crude fiber, Stift[2] made the bulb in two parts, the substance being collected in the lower part, which was removed for drying.

According to the official method in the United States,[3] 2 gm. of substance previously extracted with ether is boiled with 200 cc. of 1.25 per cent sulphuric acid for one-half hour in a flask with a reflux condenser, filtered, the residue boiled for one-half hour with 200 cc. of 1.25 per cent sodium hydroxid, with a reflux condenser as before, filtered through a Gooch crucible, washed, dried at 100° C., weighed, incinerated, and the ash deducted.

The Holdefleiss method of boiling with steam in bulbs and the American method differ essentially from the original method, and may give somewhat different results.

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[1] Landw. Jahrb. 1877, Supplement, p. 103; Bieler and Schneidewind, Versuchs-Station Halle; and E. S. R., 5, p. 459.

[2] Oesterr. ungar. Ztschr. Zuckerind. and Landw., 1895, p. 35.

[3] Association of Official Agricultural Chemists at Chicago, 1893 (U. S. Dept. Agr., Division of Chemistry Bul. 38, p. 190).

A further cause of difference in results lies in the understanding of what is meant by 1.25 per cent sulphuric acid, and 1.25 per cent potassium hydroxid, and this is seldom defined in the description of methods. Do the percentages refer to SO_3 or H_2SO_4, to K_2O or KOH? Henneberg does not specify in his original description of the method, but in another paper[1] he states explicitly that he uses "50 cc. of 5 per cent sulphuric acid (50 gm. sulphuric hydrate per liter) and 150 cc. of water," and also "50 cc. of 5 per cent potassium hydroxid (50 gm. of fused caustic potash per liter)."

This is further confirmed by Prof. F. Lehmann, Professor Henneberg's successor at the station, who states that in making the 5 per cent stock solutions 255 gm. of concentrated pure sulphuric acid (98 per cent H_2SO_4) is mixed with 4,745 gm. of water, and 300 gm. of potassium hydrate is dissolved in 6 liters of water.

E. Wolff,[2] in his book on agricultural analysis, directs that in making the 5 per cent potash solution 50 gm. of fused caustic potash be dissolved in 1 liter of water.

From the evidence adduced, the writer believes the correct solutions to be 1.25 per cent H_2SO_4 and 1.25 per cent KOH. In a method whose regularity depends upon using solutions of constant strength, it is very necessary to follow exactly the original directions of the author, or at least the method by which the majority of analyses are made.

Experiments made in the United States have shown that sulphuric acid and potash solutions of different strengths leave different amounts of crude fiber undissolved. For instance, Huston and McBride[3] found that filter paper treated with 2.5 per cent sulphuric acid and 2.5 per cent potassium hydroxid lost 17 per cent, and even more by other treatment.

In other instances linseed meal[4] gave with 1.25 per cent solutions 8.13 per cent of crude fiber, and with 2.5 per cent solutions 7.35 per cent of crude fiber, with differences of about 1 per cent between the results of different analysts.

Cellulose always attacked in the Weende method.—As cellulose is a principal constituent of crude fiber, the question as to the nature and behavior of crude fiber can be answered at least in part by determining whether in the Weende method the cellulose of feeding stuffs remains intact or whether it is partly dissolved and so goes to swell the nitrogen-free extract.

For this purpose investigations on pure cellulose treated according to the Weende method will be helpful.

Perhaps the first to make investigations along this line was H.

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[1] Landw. Vers. Stat., 6 (1864), p. 497.

[2] Anleitung zur chemischen Untersuchung landwirthschaftlich wichtiger Stoffe, Berlin, 1875, 3d ed., p. 175.

[3] Association Official Agricultural Chemists at Chicago, 1893, p. 140.

[4] Ibid., p. 131.

Schulze,[1] who, working under Henneberg's direction with 1.25 per cent and 5 per cent sulphuric acid, came to the conclusion that the 1.25 per cent acid used in the Weende method did not dissolve any essential amount of cellulose. Of 100 parts of cellulose taken, 99.17 parts remained undissolved—*i. e.*, the acid dissolved 0.83 per cent of the cellulose. The 5 per cent acid dissolved 1.46 per cent of the cellulose, and in the solution 0.64 per cent of the cellulose was recognized as dextrose by Fehling's solution.

In continuation of these experiments, G. Kühn, Aronstein, and H. Schulze[2] found that the cellulose of meadow hay, like pure cellulose, (filtered paper) was slightly attacked by boiling with 1.25 per cent sulphuric acid, but only an unimportant amount dissolved. Various samples of hay, straw, and dung treated according to F. Schulze's method (with potassium chlorate and nitric acid) showed nearly the same amounts of cellulose whether they had been previously boiled with 1.25 per cent sulphuric acid or not, although there were small differences noticeable, as shown by the following table:

Cellulose determined by F. Schulze's method.

	Without previous boiling with 1.25 per cent sulphuric acid.	With previous boiling with 1.25 per cent sulphuric acid.
	Per cent.	*Per cent.*
Clover hay	25.09	23.70
Oat straw	41.84	41.35
Dung from meadow hay	29.57	27.42
Dung from oat straw	28.78	27.92

The action of boiling 1.25 per cent potassium hydroxid is quite different, as this dissolves important amounts of cellulose. Kern[3] found that while Swedish filter paper lost only 1 per cent by being boiled with 1.25 per cent sulphuric acid, the same paper when boiled with 1.25 per cent sulphuric acid and 1.25 per cent potassium hydroxid lost 8.6 per cent. He concluded from this that paper cellulose was not noticeably dissolved by dilute sulphuric acid but was dissolved by the subsequent treatment with dilute potassium hydroxid. Without previous boiling with sulphuric acid, 1.25 per cent potassium hydroxid dissolved only 1.7 per cent.

Very similar results have recently been obtained by Suringar and Tollens.[4] Filter paper treated by the Weende method gave 92.49 to 93.96 per cent of cellulose. The same paper treated twice by the Weende method gave 95.40 to 95.86 per cent of cellulose. Cotton gave 88.18 to 90.86 per cent.

[1] Jour. Landw., 7 (1865), p. 304.
[2] Jour. Landw., 8 (1866), p. 293.
[3] Jour. Landw., 24 (1876), p. 19.
[4] Jour. Landw., 44 (1896), p. 343 (E. S. R., 8, p. 741).

Repeated combustions of the original paper and the product from treating it with sulphuric acid and potassium hydroxid, carried on in Henneberg's laboratory, showed the composition invariably to be that of cellulose, the carbon in the product ranging between 44.17 and 44.38 per cent, and the hydrogen between 6.17 and 6.19 per cent.

Kern found that the cellulose of feeding stuffs was similarly attacked. Orchard grass gave by the Weende method 34 per cent of crude fiber, and this product treated by F. Schulze's method (macerating with potassium chlorate and nitric acid) showed 32.8 per cent of cellulose in the hay; but when the hay was treated directly by Schulze's method 35 per cent of cellulose was found. In other words, 6.3 per cent of the total amount of cellulose was dissolved by the Weende method.

It follows from the above experiments that the cellulose is always somewhat attacked and dissolved by the reagents of the Weende method, and that consequently a part of the cellulose of feeding stuffs is credited to the nitrogen-free extract.

This difficulty is not removed by the modifications that have been proposed from time to time, including Wither's modification in which the operation is reversed, the substance being boiled first with potassium hydroxid and then with sulphuric acid. Furthermore, the experiments by Huston and McBride have shown that with stronger sulphuric acid and alkali the cellulose is attacked to a greater extent than with 1.25 per cent solutions.

MIXED CHARACTER OF CRUDE FIBER AND NITROGEN-FREE EXTRACT.

From what has been said, it appears that the crude fiber and nitrogen-free extract, as determined by the Weende method, must be mixtures whose constituents are changeable and a matter of chance; and that the assumption that the crude fiber is the cellulose of the vegetable substance under examination is incorrect.

The nitrogen-free extract obtained by the Weende method contains three categories of substances:

(1) True carbohydrates, including the pentosans.

(2) A variety of substances which either do not belong to the carbohydrates at all, as organic acids, lignin substances, materials of the aromatic groups, etc., or which, like mannit, are closely allied to the carbohydrates.

(3) The cellulose changed and dissolved by the 1.25 per cent acid and alkali. Since several per cent of the cellulose is always dissolved in the Weende method, somewhat less crude fiber is always found than might be expected, and a correspondingly too high amount of nitrogen-free extract. Furthermore, as the crude fiber contains other substances besides cellulose, more crude fiber than cellulose is found.

BEHAVIOR OF THE CRUDE FIBER AND NITROGEN-FREE EXTRACT IN THE HUMAN BODY.

In general.—In spite of the uncertainties in the determination of crude fiber pointed out in the preceding pages, it is a well-known fact that for years thousands of fodder analyses have been made in which crude fiber and nitrogen-free extract have been determined by the Weende method more or less modified. The question is pertinent as to how the constituents determined in this way behave in the animal body, and especially what proportion of the nitrogen-free extract and the crude fiber are used by the animal and what portion is excreted undigested.

Digestion experiments have usually shown that a large proportion, and in some cases nearly all, of the nitrogen-free extract is digested.[1] Sometimes, as in the case of leaves, hay, and straw, the figures are low—40 to 70 per cent—but in case of grains (flour, meal, etc.) they reach 90 per cent and over. These coëfficients have been obtained by digestion experiments with animals (cattle, horses, sheep, swine, geese, etc.).

Method of Stutzer and Isbert.—A method by which the digestibility of nitrogen-free extract could be determined in a shorter time than by the natural method was considered very desirable, and accordingly one was worked out by Stutzer and Isbert.[2] In this they attempted to imitate the digestion in the body with the aid of artificially prepared ferment solutions, using the ferments of the saliva (ptyalin), stomach (pepsin), and abdominal salivary gland (pancreas). Duplicate samples of 2 gm. each of the feeding stuff were first extracted with ether, and then heated to boiling with water. After cooling, 200 cc. of the ptyalin solution was added and digested for 2 hours at 37 to 40° C. (or 25 cc. diastase solution was added and digested for 2 hours at 60 to 65° C). The solution was then filtered through an asbestus filter, the residue washed, and digested for 12 hours at 37 to 40° C. with 250 cc. of a solution of pepsin from pig's stomach, care being taken that the solution contained 0.1 per cent of hydrochloric acid throughout the digestions. This was filtered through asbestos, washed, and the residue including asbestus digested for 3 hours at 37 to 40° C. with 100 cc. of alkaline pancreas solution.

In this way, by the action of ferments (ptyalin or diastase, pepsin, and pancreas) the portion of the carbohydrates which is digested in the animal body was dissolved, and there remained the undissolved portion of the nitrogen-free extract and the crude fiber (*i. e.*, the cellulose and its accompanying substances, lignin), the undissolved portion of the protein substances, a part of the ash constituents, and a considerable quantity of asbestos.

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[1] Dietrich and König, Die Zusammensetzung und Verdaulichkeit der Futtermittel. Berlin, 1891, part 2, pp. 1070–1127, 1280–1339.

[2] Ztschr. physiol. Chem., 12 (1888), p. 72; Centbl. agr. Chem., 17 (1888), p. 112.

The ash was determined in the residue from one sample by incineration and the protein in the other by the Kjeldahl method. The ash and protein deducted from the residue gave the crude fiber and undissolved nitrogen-free extract; and this plus the protein, fat, and ash found in the original substances, deducted from the amount taken, showed the nitrogen-free extract digested.

This method while not so tedious as a feeding experiment is quite long and complicated. It would probably be employed if it always gave correct results, but its accuracy has been questioned by Pfeiffer[1] who found a large difference between the results as obtained by Stutzer and Isbert and those obtained in natural digestion trials on animals.

Water-soluble portion of nitrogen-free extract.—Percentage of aqueous extract.—Other chemists have undertaken to determine by the direct method the amount of carbohydrates and similar substances in feeding stuffs, and how much of this is digestible.

Henneberg and Stohmann[2] found, for example, that in common feeding stuffs (oat straw, wheat straw, bean straw, clover, and meadow hay) the amount of substance soluble in water was approximately equal to the digestible portion of the nitrogen-free extract.

Thus the following results were obtained:

Relation between digestible nitrogen-free extract and aqueous extract.

	Total nitrogen-free extract.	Digestion coëfficient obtained in feeding experiments.	Digestible nitrogen-free extract.	Aqueous extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Oat straw	42.19	45	19.0	19.5
Wheat straw	38.93	40	15.6	13.5
Bean straw	39.91	62	24.7	24.2
Clover hay	41.89	68	28.5	28.2
Meadow hay	46.54	68	31.6	29.6

In other cases the agreement was even better. Kühn, Aronstein, and H. Schulze[3] confirmed this deduction, and J. König[4] approximately; and, although Maercker and E. Schulze[5] obtained less concordant results, the approximate agreement of the aqueous extract of feeding stuffs with the digestible nitrogen-free extract is at least very noteworthy.

Since the determination of water-soluble substances—that is, the percentage of aqueous extract—is comparatively very simple and rapid, it is of very great practical value for the judging of feeding stuffs. It is best carried out by repeatedly extracting the material with water, and

[1] Centbl. agr. Chem., 17 (1888), p. 115.

[2] Weender Beiträge, vol. 2, p. 253; Neue Weender Beiträge, p. 344.

[3] Jour. Landw., ser. 2, 2 (1867), p. 33.

[4] Dietrich and König, Die Zusammensetzung und Verdaulichkeit der Futtermittel, part 2, p. 1163.

[5] Jour. Landw., ser. 2, 6 (1871), p. 67.

then either evaporating to dryness an aliquot of the aqueous extract, weighing, and calculating to the original substance; or drying the residue from the extraction and determining the substance dissolved by difference. Henneberg and Stohmann boiled 4 to 5 gm. of the finely ground substance one-half hour with 800 cc. of water, then digested 6 to 8 hours in a water bath, made the volume to 1 liter on cooling, filtered, evaporated 500 cc. of the filtrate to dryness, weighed the residue, and calculated it to the original substance.

In this aqueous extract the reducing and nonreducing sugars can be determined by Fehling's solution, and the dextrin, starch, etc., after separating with alcohol, etc.[1]

Other methods.—Grandeau and Leclerc[2] tried other methods of extraction for determining the digestible nitrogen-free extract of meadow hay and oats. They digested the substances first with 95 per cent alcohol and determined the glucose, then with diastase to separate the starch, which was inverted with sulphuric acid and determined as dextrose; and finally with 2 per cent sulphuric acid, which dissolved a portion of the cellulose.

By this method of extraction, the principal carbohydrates of importance in nutrition are dissolved, but not the less soluble substances which are brought into solution by the action of the digestive fluids of the body. The method also contains other doubtful factors.

None of these methods for determining the digestible nitrogen-free extract have come into general use. The determination of the aqueous extract is not only more convenient but also better adapted to furnish an indication of the approximate amount of digestible nitrogen-free extract. Henneberg's aqueous extract method shows approximately the nitrogen-free extract digested by the stomach of an animal within 12 to 24 hours.

Digestibility of crude fiber.—As is well known, from 2 to 3 days or even a longer time may elapse before the undigested portion of the food is entirely excreted from the body, and during this time processes take place which can not be imitated by the solvents employed in the Weende method.

Digestion experiments with animals have shown that the crude fiber is by no means unattacked in the digestive tract, but is more or less dissolved, and so is not completely recovered in the excreta. During the long period of digestion within the body the crude fiber undergoes a special fermentation, due to the action of bacteria. As a result a part of the crude fiber, especially of the cellulose, is dissolved with the formation of lactic acid, carbon dioxid, marsh gas, etc. A part of the crude fiber is digested, and consequently less crude fiber is found in the dung than was consumed in the food.[3]

[1] See König, Untersuchung landw. und gewebllich wichtiger Stoffe. Berlin, 1891, p. 224.

[2] Ann. Sci. Agron., 1886, II, p. 357.

[3] Investigations of Ellenberger and Hofmeister, Weiske, Tappeiner, P. Holdefleiss, and others.

In fact, Henneberg and others have divided the crude fiber determined by analysis into two parts, the digestible crude fiber and the undigestible crude fiber; and special analytical studies have shown that the digestible portion of the crude fiber has the composition of cellulose ($C_6H_{10}O_5$), or 44.44 per cent of carbon, 6.17 per cent of hydrogen, and 49.38 per cent of oxygen.

In other words, more or less of the cellulose in the crude fiber is dissolved in the animal body, and it is evident that this dissolved cellulose in some way takes part in nutrition, and can not be disregarded in investigations of this character. The matter has been much discussed, and the question as to whether or not this digested cellulose acts in the same way in nutrition as the nitrogen-free extract has been answered in very different ways.

Since the crude fiber which is dissolved in the digestive tract has been found by Henneberg and other chemists (notably König) to have the composition of cellulose, a carbohydrate, and since the carbohydrates comprise the principal part of the nitrogen-free extract, it would seem to follow that the digested crude fiber would have the same nutritive effect as the digested nitrogen free extract. This conclusion appears to the writer to be at least approximately correct. But this belief is not shared by all.

The function of the food is not only to furnish materials to repair the waste and to maintain the body or produce growth or fat, but also to furnish heat and energy. For the production of heat and energy the carbohydrates (and consequently the nitrogen-free extract) are well adapted; and for a proper knowledge of their value in this respect, the desirability of knowing the heats of combustion of the carbohydrates and other constituents of the nitrogen-free extract is recognized on all sides. The heat production is the same when a substance is burned rapidly and with a flame in oxygen as when it is slowly changed by the respiration of the animal into carbon dioxid and water.

Frankland, Berthelot, and Stohmann especially, have made large numbers of determinations of the heats of combustion of various substances,[1] and from the fuel value calculated for 1 gm. of this or that feeding stuff a conclusion can be drawn as to its value in nutrition.

In the production of heat by the oxidation of organic matter, it is immaterial whether or not in the change to carbon dioxid and water intermediate products are formed which in turn are oxidized to carbon dioxid. But it is by no means immaterial when intermediate products are formed which prevent a complete oxidation. This is the case with a product which often results from the decomposition of the carbohydrates, namely, marsh gas, or methan (CH_4), which is formed in large quantities in the stomachs of ruminants and is given off into the air unoxidized, so that the heat of its carbon is lost. As mentioned above, a part of the cellulose is dissolved in the process of digestion as a result

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

of a fermentation in which marsh gas is generated, and hence the full fuel value of this cellulose is not realized in the body.

It would follow from this that the so-called digestible cellulose has less value than the digested nitrogen-free extract, but this is only true provided the carbohydrates of the nitrogen-free extract do not undergo a marsh-gas fermentation, or produce any methan. Some authors ascribe to the digested cellulose very little or no value, while others believe it to be fully equal to the digested nitrogen-free extract. P. Holdefleiss,[1] who has recently investigated the subject, calculates it to have 80 per cent of the value of nitrogen-free extract.

Up to the present time it has not been shown that methan, or marsh gas, comes entirely from the digested cellulose. On the contrary, it is very probable that methan also results from decomposed starch, etc., of the feeding stuff, and in this case the decrease in fuel value due to methan formation, mentioned above, would apply equally as well to the nitrogen-free extract as to the digested cellulose.

The conclusion appears to the writer to be warranted that the digested crude fiber and the digested nitrogen-free extract are not only of similar, but in all respects equivalent, value in nutrition. Certainly not all of the crude fiber eaten by animals is recovered in the excrement. Of the 46.93 per cent of crude fiber in wheat meal 52 per cent is digested by cattle, according to Henneberg and Stohmann,[2] *i. e.*, the meal contains 24 per cent of digestible crude fiber; and of the 42.96 per cent of crude fiber in oat straw 50 per cent is digested by sheep, equivalent to 21.48 per cent of digestible fiber in the straw.[3] Other data are as follows:

Digestibility of crude fiber.

	Crude fiber content.	Digestion coëfficient of crude fiber.	Digestible crude fiber in the material.	Animal used.
	Per cent.	*Per cent.*	*Per cent.*	
Bean straw	41.67	41.20	17.17	Sheep.
Oats *a*	12.07	21.04	2.54	Horse.
Oats	12.07	29.88	3.61	Sheep.
Corn meal *b*	1.75	61.89	1.08	Do.
Corn meal *c*	2.15	40.46	.87	Horse.

a Dietrich and König, loc. cit., p. 1108.
b Wolff, Funke, Kreuzhage, and Kellner, Landw. Jahrb., 8 (1879), Sup. I, pp. 96, 97.
c Dietrich and König, loc. cit. p. 1109.

It appears that quite a large part of the crude fiber is digested, and hence the assumption that the portion of a feeding stuff insoluble in 1.25 per cent sulphuric acid and 1.25 per cent potassium hydroxid is not dissolved in the body of the animal is incorrect.

[1] Landw. Inst. Halle, Berichte 12, pp. 52, 98.

[2] Weender Beiträge, vol. 2, p. 23; Dietrich and König, Zusammensetzung und Verdaulichkeit der Futtermittel, part 2, p. 1097.

[3] Hofmeister, Landw. Vers. Stat. 10 (1868), p. 295; Dietrich and König, loc. cit., p. 1098.

Since the crude fiber is partially digested, and the nitrogen-free extract is incompletely digested, and since analysis does not show the actual feeding value of either of these constituents, their estimation separately might be regarded as unnecessary. The percentage of each found by analysis shows nothing of much importance. Hence, it might be considered sufficient to determine the crude fiber and nitrogen-free extract together by difference, deducting the sum of the fat, protein, ash, and water from 100. As a matter of fact, B. König considers their separate determination of comparatively little value, and Atwater[1] groups the constituents of human foods under protein, fat, ash, and carbohydrates.

The nitrogen-free extract approximately equal to the sum of the digestible crude fiber and digestible nitrogen-free extract.—The feeding and respiration experiments of Henneberg and Stohmann, and of others, have shown that the amount of crude fiber digested agrees approximately with the amount of nitrogen-free extract left undigested. Hence the percentage of nitrogen-free extract found by the Weende method is practically equivalent to the sum of the digestible nitrogen-free extract and the digestible crude fiber. Henneberg and Stohmann[2] state, for instance, that "the undigested part of the nitrogen-free extract compensates for the digestible part of the crude fiber, and is to be regarded as lignin; the digestible part bears the closest relation to the water-soluble constituents of coarse fodder."

This rule follows with more or less exactness from the original data given by Henneberg, as well as from that furnished from time to time by various investigators, and a study of the data presented in Dietrich and König's excellent compilation suffices to confirm the rule. The following data from that source will serve to illustrate:

Relation between the total nitrogen-free extract and the sum of the digestible fiber and nitrogen-free extract.

Number in Dietrich and König's tables.	Substance (dry).	Found by the Weende method of analysis.		Digestible materials calculated from feeding experiments.		Sum of digestible portions of crude fiber and nitrogen-free extract.
		Crude fiber.	Nitrogen-free extract.	Crude fiber.	Nitrogen-free extract.	
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
6	Dactylis glomerata	27.02	52.75	15.93	35.34	51.27
18	Wheat beginning to shoot	25.75	46.91	16.74	31.89	48.63
20	Fodder corn	28.63	53.80	16.03	34.43	50.46
24	Meadow grass	33.12	43.90	20.20	29.85	50.05
29	Green clover	30.27	42.00	16.65	29.40	46.05
67	Beet leaves	14.35	41.86	8.32	31.40	39.72
129	Meadow hay (average)	29.24	49.74	17.54	31.83	49.37
135	Mountain hay	27.12	53.31	16.81	35.18	51.99
168	Wheat straw	43.00	45.00	23.65	17.55	41.20
176	Oat straw	43.04	44.92	24.96	22.91	47.87
178	Corn stover	31.98	53.07	17.59	23.88	41.47
185	Pea straw	41.03	39.04	16.01	21.48	37.49
225	Potatoes	2.75	83.86	1.51	82.18	83.69
232	Beets	7.68	72.15	4.22	69.26	73.48
236	Wheat	2.19	79.71	1.10	75.72	76.82
249	Corn	2.55	78.53	1.28	74.60	75.88

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.
[2] Weender Beiträge, vol. 2, pp. 454, 455.

It is seen that the sum of the crude fiber and nitrogen-free extract digested by animals in many cases agrees almost exactly with the total amount of nitrogen-free extract found by the Weende method. In some instances, as in Nos. 129 and 225, the agreement is complete, while in most cases the difference amounts to only a few per cent, being large in only a few cases (Nos. 24 and 178).

As a rule, then, the percentage of nitrogen-free extract found by the Weende method is approximately equivalent to the sum of the digestible crude fiber and the digestible nitrogen-free extract.

The difference between the nitrogen-free extract and the aqueous extract gives the digestible cellulose.—We can go one step farther and combine the figures for nitrogen-free extract and aqueous extract. As stated above, the aqueous extract agrees approximately with the digestible nitrogen-free extract, and it follows that deducting the percentage of aqueous extract from the percentage of nitrogen-free extract will give as the remainder the percentage of undigestible nitrogen-free extract. But, as stated above, the undigested portion of the nitrogen-free extract is approximately equal to the digested portion of the crude fiber; and hence subtracting the percentage of aqueous extract from the percentage of nitrogen-free extract gives the percentage of digestible cellulose.

Although these rules are only approximately correct, comparing in some cases very well and occasionally not so well with the results of digestion experiments, the figures obtained by means of them are at least good indications of the value of feeding stuffs, and they can be widely employed since they are derived with much less time and labor than the more exact figures obtained in digestion experiments.

It is recommended to continue the use of Henneberg's original Weende method of analysis until a better method is elaborated, and to supplement this by the determination of aqueous extract, which heretofore has not been general.

If more explicit information is desired as to the various constituents of the nitrogen-free extract, the starch, sugar, organic acids, etc., they may be determined by the methods referred to above.

The pentosans should be more frequently determined than at present, because it is probable, though not entirely certain, that the pentosans have the same nutritive value as the hexose carbohydrates.[1]

CONCLUSION.

From the above discussion of the subject it follows that the Weende method for the analysis of feeding stuffs is not to be regarded as an exact method, since the constituents determined by it are not chemically

[1] See investigations of Stone and Jones, Ber. deut. chem. Ges., 25 (1892), p. 563; of Lindsey and Holland, Massachusetts State Sta. Rpt. 1894, p. 186; of Weiske, Ztschr. physiol. Chem., 20 (1895), p. 494; of Pfeiffer, Landw. Vers. Stat., 47 (1896), p. 59; of Tollens, Jour. Landw., 44 (1896), p. 171.

definite substances of fixed composition but quite variable mixtures; and the method does not permit of the exact separation of these mixtures from one another.

The nitrogen-free extract is a complicated mixture of many different substances, in which the carbohydrates predominate; and the separation of the nitrogen-free extract from the crude fiber, likewise a mixture, is quite incomplete.

In spite of all these difficulties, the Weende method has rendered a great service to the science and practice of nutrition of man and animals, and it may be used in future until a better method is found.[1]

In conclusion, a statement made by Henneberg himself in regard to the value of his method of analysis may be cited, because it is apparent from it that Henneberg clearly recognized the weaknesses as well as the advantages of his method. In the autograph manifolds of his lectures, which he was accustomed to distribute among the students attending his lectures, Henneberg says (p. 43): "In order to ascertain the value of a feeding stuff for nutrition, it is necessary to determine the content of all the separate constituents, or at least of all the groups of similar value, and so far as the cellulose is concerned, the various modifications of the same. These requirements the customary analysis of vegetable feeding stuffs by no means fulfills." And he adds (p. 44): "The present method of fodder analysis needs greatly to be perfected, but in many respects accomplishes more than would be expected from its defectiveness."

[1]In a recent publication (U. S. Dept. Agr., Office of Experiment Stations Bul. No. 21, pp. 46–48) Atwater makes a similar statement in regard to results by the Weende method. He points out the indefinite nature of the crude fiber and the nitrogen-free extract, and their very mixed character, and emphasizes the great desirability of new and reliable methods for the analysis of feeding stuffs.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The action of enzymic ferments upon starches of different origin, W. E. STONE (*U. S. Dept. Agr., Office of Experiment Stations Bul. 34, pp. 29–44*).—The author refers to the differences which have been noticed between starches from various plants. He reports studies made to compare the susceptibility of different starches to a number of enzymic ferments, viz, diastase, salivary enzyms, pancreatic enzyms, and "Taka-diastase." The starches were freshly prepared from maize, wheat, rice, potatoes, and sweet potatoes. They were gelatinized by heating in water. Varying amounts of starch were treated with solutions of the enzyms of different strengths, and the time noted which was required for complete solution or saccharification, as shown by the iodin reaction.

The following conclusions were reached:

"(1) The starches of potato, sweet potato, maize, rice, and wheat vary greatly in their susceptibility to the action of enzymic ferments.

"(2) This variation reaches such a degree that under precisely the same conditions certain of the starches require eighty times as long as others for complete solution or saccharification.

"(3) This variation is exhibited toward all of the common enzymic ferments studied, viz, diastase, ptyalin, pancreatin, and "Taka-diastase," in the same relative order, with slight exception.

"(4) This order, beginning with the starch which is most easily changed, is, for malt extract—sweet potato, potato, wheat, and maize; for saliva—potato, sweet potato, maize, rice, and wheat; for pancreatic fluids—potato, sweet potato, maize, with wheat and rice unchanged; for 'Taka-diastase' the potato was more quickly changed than any other.

"(5) Certain of the experiments indicate that the rapidity of the change in particular cases is very clearly proportional to the concentration of the solution of the ferment.

"(6) It seems reasonable to assume that the same relative degree of susceptibility exhibited by these starches in the experiments described would still obtain when they are subjected to the action of the same enzyms in the processes of digestion.

"(7) The facts here presented have very important bearings upon industrial operations involving the use of starches, upon questions of physiology and nutrition, and upon the study of the different starches from the purely scientific standpoint."

Determinations of alumina and oxid of iron in mineral phosphates, manures, sulphate of alumina, alum, etc., R. T. THOMPSON (*Jour. Soc. Chem. Ind.*, *15* (*1896*), *No. 12*, *p. 868*, *869*).—The unsatisfactory character of the methods in use for the precipitation of iron and alumina as phosphates is due to the fact that all the conditions which tend to cause inaccuracy are not taken into account. It is necessary to consider how to obtain the precipitate free from calcium phosphate as well as to obtain and keep it in the perfectly normal condition. The presence of ammonium acetate favors the precipitation of calcium phosphate, even in the cold. The neutralization process formerly proposed by the author[1] avoids this difficulty. To the cold solution of the phosphate ammonia is added until it is neutral or only faintly acid to lacmoid paper, when the whole of the aluminum and iron phosphates will be precipitated and the calcium phosphate will remain in solution. In order that the phosphates of iron and alumina be normal, at least 1½ times the amount of phosphoric acid theoretically required must be present, otherwise the phosphates will be basic and of uncertain composition. To preserve the normal composition of the precipitate, it is washed with a 1 per cent solution of ammonium nitrate containing 0.2 gm. of diphosphate of ammonium (NH_4HPO_4) per liter. The ammonium phosphate must be exactly neutral to methyl orange. If fluorids are present, the solution of the phosphate is to be previously evaporated with nitric acid. The process serves also for the separation of alumina and oxid of iron from cobalt, nickel, zinc, and manganese, as well as from calcium and magnesium.—A. M. PETER.

A modification of the Gunning method for nitrates, J. FIELDS (*Jour. Amer. Chem. Soc.*, *18* (*1896*), *No. 12*, *pp. 1102–1104*).—The modification consists in substituting for the 5 gm. of sodium thiosulphate and 10 gm. of potassium sulphate of the official method 6 to 7 gm. of potassium sulphid, which is added in small portions, the flask being thoroughly shaken after each addition. It is claimed that with this reagent frothing is avoided and the time of digestion shortened.—F. W. MORSE.

The determination of sulphuric acid or of barium, J. EDMUNDS (*Chem. News*, *74* (*1896*), *No. 1925*, *p. 187*).—The method is intended especially for determining sulphuric acid in water. Seventy centimeters of the water is first titrated with an excess of deci-normal barium nitrate, the excess of barium precipitated with an excess of deci-normal potassium chromate, and the excess of potassium chromate precipitated with an excess of deci-normal silver nitrate. The excess of silver nitrate is determined in the usual way in a portion of the filtrate, and from this data the sulphuric acid is calculated.—B. W. KILGORE.

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[1] Jour. Soc. Chem. Ind., 5 (1886), p. 152.

The carbohydrates of wheat, maize, flour, and bread, W. E. Stone (*U. S. Dept. Agr., Office of Experiment Stations Bul. 34, pp. 7–28*).—This is a study of the carbohydrates of winter and spring wheat, maize, flour from winter and spring wheat and maize, and bread made from the same. Analyses are given of the materials by the ordinary Weende method, and in addition the individual carbohydrates are determined by a method described in the bulletin. The carbohydrates determined were sucrose, invert sugar, dextrin, starch, pentosans and hemicelluloses, and fiber. The changes in making bread are discussed and data are given for the bread-making experiments.

"Flour made from wheat undergoes a selective process which leaves the carbohydrates in different proportions than in the whole grain. Sucrose and crude fiber are notably diminished; invert sugar and pentosans disappear entirely, while the starch and dextrin are proportionally increased. . . .

"The combined action of moisture, yeast, and heat, as in preparing and baking bread, diminishes the sugar and tends to convert the starch into soluble and fermentable forms. The actual amount of starch thus changed is, however, much less than is generally supposed, averaging in the materials studied not more than 10 per cent of the total starch present. This change occurs in the more exposed portions of the loaf. In the interior the starch practically undergoes no change.

"The temperature of the interior of loaves of bread baked in the ordinary way was never found to exceed 99° C.

"The total shrinkage in weight during the process of 'raising,' baking, and 'airing' bread amounts to from 12 to 20 per cent of the total weight of materials used. This loss is, however, almost entirely in moisture which has been added to the flour, and which is removed by evaporation. The total loss of solid or dry matter will not exceed 3 or 4 per cent on the average.

"Bread contains all of the varieties of carbohydrates found in the original flour, and in addition more or less of so-called 'soluble starch' produced by the action of heat upon the normal starch."

The important feature of these investigations is the attempt made to determine the various carbohydrates directly, instead of grouping them together under the head of nitrogen-free extract determined by difference. The method has been somewhat changed by further investigation, and in its modified form is given by the author in a more recent paper noted below.

The quantitative determination of carbohydrates in food stuffs, I, W. E. Stone (*Jour. Amer. Chem. Soc., 19 (1897), No. 3, pp. 183–197*).—After discussing the unsatisfactory character of the determination of nitrogen-free extract by difference the author outlines a method for determining the separate carbohydrates in feeding stuffs. This is based upon the successive treatment of the sample (1) with boiling alcohol to remove sugars; (2) with cold water to remove dextrin and soluble forms of starch; (3) with diastase or malt infusion to remove starch; (4) with dilute boiling hydrochloric acid to convert the gums, pentosans, hemicelluloses, etc., into soluble reducing sugars; and (5) with boiling 1.25 per cent sodium hydroxid, leaving the crude fiber behind.

The method is briefly as follows: From 50 to 100 gm. of finely ground or grated material is boiled with 500 cc. of strong alcohol under a reflux

condenser for 2 hours, or is extracted with boiling alcohol in a Soxhlet extractor. The sugars extracted are determined either in the polarimeter, if only sucrose is present, or by titration with Fehling's solution before and after inversion. The residue from the alcoholic extraction is treated with 500 cc. of water for 18 to 24 hours with frequent agitation, the aqueous extract evaporated to 200 cc., and an aliquot part inverted with dilute acid and titrated with Fehling's solution. The residue from the aqueous extract is brought to an air-dry condition, weighed, and 2 gm. of the material boiled thoroughly with 100 cc. of water for 3 minutes to gelatinize the starch. A malt infusion is prepared by digesting 10 gm. of finely ground fresh malt with 50 cc. of water at ordinary temperature, with frequent agitation for 2 to 3 hours. The gelatinized starch is treated with 10 cc. of this infusion at a temperature not exceeding 65° C. from 2 to 3 hours, or until the iodin reaction disappears, when the solution is filtered on a linen filter and thoroughly washed with hot water. The filtrate is evaporated to 100 cc. and treated with 10 cc. of concentrated hydrochloric acid at the temperature of a boiling water bath for 1 hour, in order to convert the malt sugar into dextrose, the solution neutralized, made to a volume of 200 cc., and titrated with Fehling's solution. The result is corrected for the sugar introduced in the malt extract. The residue from the malt extraction receives 100 cc. of water and 2 cc. of strong hydrochloric acid and is heated to boiling under a reflux condenser or in a water bath for 1 hour, in order to convert the gums and pentosans into reducing sugars which may be regarded as xylose. The solution is filtered, neutralized, made to 200 cc., and titrated with Fehling's solution. The residue is treated with 1.25 per cent sodium hydroxid as in the Weende method for crude fiber, and the remainder taken as crude fiber.

In conclusion the author says:

"In many cases it is believed that the total amount of carbohydrates thus definitely determined in food materials will be found to be appreciably less than the nitrogen-free extract estimated by difference. If subsequent research should justify this belief, the character of this non-carbohydrate and non-nitrogenous substance would remain to be determined. This question is now being investigated, and for the present the writer desires to reserve the subject of inquiry to this laboratory.

"This outline is thought to present an analytical method superior to anything at present available for the estimation of carbohydrates in foods, although it can not be regarded as in any sense perfected. It will have served its purpose if it shall suggest to others the necessity of something better and assist them in the search for it."

The quantitative determination of carbohydrates in food stuffs, II, W. E. STONE (*Jour. Amer. Chem. Soc., 19 (1897), No. 4, pp. 347–349*).— In this paper the author gives the percentages of starch in maize, wheat, flour, and bread, as determined by his revised method (see above), and summarizes the determinations made of the different carbohydrates of these substances. The summary is given on the following page:

Carbohydrates in different food stuffs (in dry matter).

	Sucrose.	Invert sugar.	Dextrin.	Soluble starch.	Normal starch.	Pentosans.	Crude fiber.	Total carbohydrates.	Nitrogen-free extract.
	Per ct.	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per cent.*
Wheat 1	0.52	0.08	0.27	0.00	57.62	4.54	2.68	65.71	77.07
Wheat 2	.72	.00	.41	.00	56.27	4.37	2.51	64.28	77.66
Flour 1	.18	.00	.90	.00	67.99	.00	.25	69.32	83.54
Flour 2	.20	.00	1.06	.00	67.76	.00	.25	69.27	84.54
Maize	.27	.00	.32	.00	65.45	5.14	1.99	73.17	78.02
Bread (wheat 1)	.14	.10	.68	1.37	53.54	4.16	2.70	62.59	77.20
Bread (wheat 2)	.05	.32	.23	2.36	53.62	4.34	2.42	63.34	77.33
Bread (flour 1)	.06	.37	.27	1.99	64.81	.00	.34	67.84	82.94
Bread (flour 2)	.15	.38	.91	1.74	64.12	.00	.17	67.47	85.17
Corn bread (maize)	.16	.19	.00	2.80	61.74	3.54	2.22	70.75	77.81

The author states that the discrepancy between the total carbohydrates and the nitrogen-free extract "is diminished by the later results, but still exists to an extent which can not be overlooked."

Method of determining the acidity of milk, A. DEVARDA (*Milch Ztg., 25 (1896), No. 49, p. 785, fig. 1*).—The apparatus used in this method is called an acidimeter. It is a glass-stoppered flask of about 100 cc. capacity with graduated neck. One hundred cubic centimeters of milk is placed in the flask, phenolphthalein added and then decinormal alkali added as in ordinary titration. At the end of the reaction the amount of alkali added is read off on the graduated neck and the acidity calculated.

Several comparisons of this method with Soxhlet's method showed that the two gave nearly identical results.

Contribution to the knowledge of the rancidity of fats, E. SPAETH (*Ztschr. analyt. Chem., 35 (1896), p. 471*).—The author worked on hog's lard. He found that the fats on standing became rancid and ascribed it to oxidation due to the action of light and atmospheric oxygen, the unsaturated oleic acid being chiefly attacked, with the formation of acids with lower percentage of carbon. Aldehyde bodies and oxy-fatty acids were also formed. All the fats contributed to the formation of free fatty acids, and the volatile fatty acids increased greatly with the increase of free fatty acids. The oxidized fats had a lower iodin number and higher melting point than the fresh fats.—B. W. KILGORE.

On the determination of stearic acid in fats, O. HEHNER and C. A. MITCHELL (*Analyst, 21 (1896), Dec., p. 316–332*).—The method, which numerous trials on a variety of materials has indicated to be quite reliable, is as follows: Prepare a supply of alcohol (methylated) saturated at 0° C. with pure stearic acid, or with stearic acid which only contains traces of palmitic acid. Dissolve from 0.5 to 1 gm. of the mixture of the fatty acids to be examined, if these acids are solid, or about 5 gm. if fluid, in about 100 cc. (exact measurement is not necessary) of the stearic-acid-alcohol solution. Leave in an ice bath over night, agitate next morning and allow to stand in ice for a short time, filter off while the mixture remains in ice, wash with stearic-acid-alcohol

at 0° C., dry and weigh. Determine the melting point of the product, which should not be much less than 68.5° C.—B. W. KILGORE.

The chemical examination of cheese, A. STUTZER (*Ztschr. analyt. Chem., 35 (1896), p. 493*).—Ash is determined by ignition in a platinum dish in a muffle furnace. For the other determinations 100 gm. of cheese is rubbed up with 400 gm. of clean sand. Water is determined in 3 gm. of the mixture by heating in a water bath, and fat is estimated in this by extraction with dry ether. Total nitrogen is estimated by the Kjeldahl method. The author uses phosphotungstic acid for separating casein, albuminates, albumoses, etc., from amids, and estimates ammoniacal nitrogen by distillation with barium carbonate. Nitrogen in amido-compounds is determined in the filtrate from the phosphotungstic acid precipitate.—B. W. KILGORE.

Valuation and standardization of permanganate solutions, E. RIEGLER (*Ztschr. analyt. Chem., 35 (1896), p. 522*).—As permanganate solutions change on standing, the author uses a solution of chemically pure oxalic acid, containing 9.9654 gm. of oxalic acid and 50 cc. of concentrated sulphuric acid to the liter, for standardizing his permanganate each time it is used. One cubic centimeter of the oxalic acid solution is equal to 0.005 gm. of potassium permanganate. For the titration the oxalic acid solution is heated to boiling and the permanganate added until permanent rose coloration.—B. W. KILGORE.

Classification of the chemical elements, LECOQ and DE BOISBAWDRAN (*Compt. Rend., 124 (1897), No. 3, pp. 127–130*).

Lucium, a new element (*Chem. News, 74 (1896), No. 1922, p. 159*).

The alleged new element, lucium, W. CROOKES (*Chem. News, 74 (1896), No. 1931, p. 259*).—The author concludes from chemical and spectral analysis that lucia is nothing more than yttria in a rather impure condition.—B. W. KILGORE.

The unity of atomic weights, K. SEUBERT (*Ztschr. anorgan. Chem., 13 (1896), No. 4–5, pp. 229–232*).

Water in colloids, especially in gelatinous silicic acid, J. M. VAN BEMMELEN (*Ztschr. anorgan. Chem., 13 (1896), No. 4–5, pp. 233–314, figs. 2*).

On the alkalimetric determination of metals, H. LESCOEURS ET AL (*Bul. Soc. Chim. Paris, 17–18 (1897), No. 2, pp. 119–144*).

The accurate determination of oxygen by absorption with alkaline pyrogallol solution, F. CLOWES (*Chem. News, 74 (1896), No. 1926, p. 199*).

A new method for the quantitative separation of alkaloids suitable for analytical purposes, C. KIPPENBERGER (*Ztschr. analyt. Chem., 35 (1896), p. 407*).

The application of solutions of iodin for the volumetric determination of solutions of alkaloids, C. KIPPENBERGER (*Ztschr. analyt. Chem., 35 (1896), p. 422*).

The determination of potassium bitartrate in wines, H. GAUTIER (*Compt. Rend., 124 (1897), No. 6, pp. 298–300*).

Note on the analysis of cream of tartar, A. H. ALLEN (*Analyst, 21 (1896), Aug. p. 209*).—This is a correction to a former paper on the same subject.[1]

Recognition of formic aldehyde in milk, K. FARNSTEINER (*Forsch. ü. Lebensmtl. und Hyg. Chem., 3 (1896), pp. 363–370; abs. in Chem. Centbl., 1897, I, No. 2, p. 133*).

On Chinese vegetable tallow, G. DE NEGRI and G. SBURLATI (*Chem. Ztg., 21 (1897), No. 1, pp. 5, 6*).

Recognition of pure butter, margarine, and other animal and vegetable fats, and of mixtures of the same (*German patent No. 89440; Chem. Ztg., 21 (1897), No.*

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[1] Analyst, 21 (1896), July, No. 244.

2, p. 13).—The fat is thoroughly mixed with water or some aqueous alkali-free solution at over 31° C., and from the rapidity with which the fat separates and its physical properties, its nature is determined. Salt solution can be used in place of pure water; and various tests can be made on the separated fat.

A color reaction of peanut oil, A. VAN ENGELEN (*Bul. Assoc. Belge Chim., 1896, No. 4*).

Note on the microscopic detection of beef fat in lard, T. S. GLADDING (*Analyst, 21 (1896), Oct., p. 254*).—The author obtains crystals of beef stearin of good form and size by crystallizing from a mixture of alcohol and ether (10:5).—B. W. KILGORE.

The introduction of standard methods of analysis, H. J. VON JONSTORFF (*Chem. News, 74 (1896), Nos. 1917, p. 89; 1918, p. 101; 1919, p. 118; 1921, p. 143; 1922, p. 159; 1923, p. 170*).

A new form of potash bulb, M. GOMBERG (*Jour. Amer. Chem. Soc., 18 (1896), No. 11, pp. 941, 942, fig. 1*).—Much simpler than Geissler's. It may be easily handled and wiped, will stand without support, and can be weighed without being suspended.—F. W. MORSE.

A modified form of the ebullioscope, H. W. WILEY (*Jour. Amer. Chem. Soc., 18 (1896), No. 12, pp. 1063-1067, fig. 1*).—The difficulties attending the use of the ebullioscope in determining alcohol in wine and beer are discussed, and a description is given of a form of the apparatus devised to overcome the difficulties.—F. W. MORSE.

A filter flask, W. DIAMOND (*Chem. News, 74 (1896), No. 1933, p. 283*).

Rapid measuring pipette, E. L. SMITH (*Jour. Amer. Chem. Soc., 18 (1896), No. 10, pp. 905, 906, fig. 1*).—An apparatus for quickly measuring successive, equal volumes of a solution, when great accuracy is not required; it may be prepared from ordinary laboratory stock.—F. W. MORSE.

BOTANY.

Investigations concerning the formation of albuminoids in plants, T. KOSUTANY (*Landw. Vers. Sta., 48 (1896), No. 1, pp. 13-32*).—The effect of assimilation and its associated processes upon the production of albuminoids in the plant has been investigated. The material studied was leaves of a wild riparia grape. In order to get portions that would be comparable, the leaf blade was quickly cut along the midrib with scissors and half removed between 2 and 3 p. m., the other portion at about 3 a. m., and analyzed. The combined nitrogen, the albuminoid nitrogen and other nitrogenous compounds, the acid and sugar content, and the ash were determined, the methods for the analyses being given. The experiment was continued from June 21 to August 30, 1894, and the results are given in detail.

The total nitrogen compounds fell off about one-fourth between the first and last dates given. The combined nitrogen content was greater at night than in the day, while there was less nonalbuminoid nitrogen compounds at night. Ammonium salts were found more abundant at night. The leaves contained a greater amount of nitric acid in the day than at night. The portions of leaves collected at night were found not to contain any asparagin. It appears that while the raw material for albuminoid formation is most abundant in the day, yet there is a greater conversion of this material during the night. More sugar is present in the leaves during the day than at night, while the greater content of the free acids is found at night.

The water content varied with the different periods, and was greater at night than in the day. The ash content increased toward the end, as shown by a second series of experiments.

In 1895 similar experiments were conducted, the material being collected at biweekly periods and examined as before. The results, which are described in detail, confirm those of the previous year already given.

Concerning the varying crystallizable nitrogenous compounds in germinating plants, E. SCHULZE (*Ztschr. physiol. Chem.*, *22* (*1896*), *No. 4–5*, *pp. 411–431*).—The author has investigated the nitrogenous compounds in germinating plants of vetch, and white, yellow, and blue lupines, studying the variations due to the processes of growth. It is shown that different species of the same genus of plants may contain very different nitrogen contents. The cotyledons of young plants of the yellow lupine contain considerable arginin, while it is almost or entirely wanting in the white and blue lupines. In a like manner, in etiolated plants of *Lupinus angustifolius* leucin but no phenylalanin is found. On the contrary, *L. luteus* and *L. albus* contain phenylalanin but no leucin. In gourd plantlets as well as those of *Picea excelsa* sometimes glutamin and sometimes asparagin is to be found. Green plants of *Vicia sativa* and *Lupinus luteus* contained only leucin, while the etiolated plantlets of the vetch contained leucin, amido-valerianic acid, and phenylalanin; the etiolated lupine seedlings contained only amido-valerianic acid and phenylalanin.

Concerning the distribution of glutamin in plants, E. SCHULZE (*Landw. Vers. Sta.*, *48* (*1896*), *No. 1*, *pp. 33–55*).—In 1883 the author and E. Bosshard[1] showed glutamin to be a constituent of the juice extracted from garden beets. In the present paper an extended report is given of examinations made of many plants for the presence of this substance, which is considered homologous with asparagin. The detailed methods of separation are reported. The method of treatment gives glutamin, an amid compound which is characterized by small needle-shaped crystals containing no water of crystallization. The crystals are somewhat soluble in cold water but not in absolute alcohol. When heated with caustic soda ammonia is given off, or with very dilute hydrochloric acid the ammonia is split up. A warm aqueous solution treated with copper hydroxid gives nearly insoluble copper-glutamin crystals readily recognized under the microscope.

The author investigated the roots of garden and sugar beets, carrots, kohl-rabi, celery, and radish; tubers of *Stachys tuberifera*, etiolated plants of gourd, castor bean, rape, white mustard, and sunflower; and the green parts of growing plants of *Saponaria officinalis*, garden beets, kohl-rabi, *Pteris aquilina*, *Aspidium filix mas*, and *Asplenium filix fœmina*. In each of these 16 different species, representing 9 orders of plants, glutamin was found, while the investigation of tubers of artichoke and dahlia and chicory roots gave negative results.

[1] Landw. Vers. Sta., 29 (1883), p. 295.

The author thinks that glutamin plays a rôle similar to that of asparagin in the plant, and that it is stored up in a similar way and for the same purpose.

Concerning a new conidial form of Chætomium, E. BOULANGER (*Rev. gén. Bot., 9 (1897), No. 1, pp. 17–26, pls. 3*).

Investigations on the systematic anatomy of the Betulaceæ and the Corylaceæ (*Thesis. Genoa, 1896; abs. in Bot. Centbl., 69 (1897), No. 4, pp. 118, 119*).—Anatomical characters are given for the recognition of the different genera of these families.

Comparative anatomy of Echinocactus, Mamillaria, and Anhalonium, P. MICHAELIS (*Inaug. Diss. Erlangen, 1896, pp. 38; abs. in Bot. Centbl., 69 (1897), No. 5, p. 145*).

Concerning the alkaloids of Lupinus albus and L. angustifolius, L. S. DAVIS (*Inaug. Diss. Marburg, 1896, pp. 666; abs. in Bot. Centbl. Beihefte, 6 (1896) No. 6, pp. 454, 455*).

Concerning the seed coats of Solanaceæ, C. HARTWICH (*Festschrift Naturf. Ges. Zurich, 1896, II, pp. 366–382, pl. 1*).

Investigations on the extent of the assimilatory tissues of plants, E. BLOHM (*Inaug. Diss. Kiel, 1896, pp. 44*).

On the osmotic pressure in the cells of leaves, H. H. DIXON (*Proc. Roy. Irish Acad., ser. 3, 4 (1896), pp. 65–73*).

Concerning the changes in the protein in germinating conifer plants which contain nitrogen compounds, E. SCHULZE (*Ztschr. physiol. Chem., 22 (1896), No. 4–5, pp. 435–448*).

Concerning the influence of temperature on the osmotic processes of the living cell, G. KRABBE (*Pringsheim's Jahrb. wiss. Bot., 29 (1896), No. 3, pp. 441–498*).

The influence of intense light on the cell division of Saccharomyces cerevisiæ and other yeasts, W. LOHMANN (*Inaug. Diss. Rostock, 1896; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 25–26, pp. 797, 798*).

Comparative studies on the poisonous effect of various chemical substances on algæ and infusoria, T. BOKORNY (*Arch. ges. Physiol., 64 (1896), p. 262; abs. in Bot. Centbl., 69 (1897), No. 1, pp. 25–27*).

Changes in cell organs of Drosera rotundifolia produced by feeding with egg albumen, LILY HINE (*Quart. Jour. Micros. Sci., 39 (1897), No. 4, pp. 387–425, pls. 2*)

The function of potash in assimilation in the plant organism, MITTELSTAEDT (*Neue Ztschr. Rubenz. Ind., 37 (1896), p. 93; abs. in Chem. Ztg., 20 (1896), No. 74, Repert., p. 235*).

Concerning positive and negative heliotropism, F. OLTMANNS (*Flora, 83 (1896), No. 1*).

The biology of pollen, A. HANSGIRG (*Oesterr. Bot. Ztschr., 47 (1897), No. 2, pp. 48–52*).

Concerning spore dissemination by rain, K. GÖBEL (*Flora, 82 (1896), No. 4*).

Preliminary report on the spermatazoids of Cycas revoluta, S. IKENO (*Bot. Centbl., 69 (1897), No. 1, pp. 1–3*).—The author claims to have observed spermatozoids in the pollen tubes of *Cycas revoluta*.

Notes on the flowers of crucifers, E. MARCHAND (*Bul. Soc. sci. nat. l'ouest France, 6 (1896), No. 3, pp. 159–171, pl. 1*).

Plants as irritable organisms, J. B. FARMER (*Bul. Pharm., 11 (1897), No. 1, pp. 22–24*).—A semipopular lecture on plant response to stimuli.

Note on "double rice," D. PRAIN (*Proc. Asiatic Soc. Bengal, 1896, No. 4, pp. 65, 66, pl. 1*).—Notes are given of a sport of rice, which normally produces two, sometimes three, grains instead of the usual one to the flower. This is brought about by a proliferation in the gynæcium without any other abnormality in the flower. In the gynæcium of over 150 flowers examined there were from 4 to 7 ovaries present. The sport is said to come true to seed.

Analysis of air by a mushroom, T. L. PHIPSON (*Chem. News, 74 (1896), No. 1930, p. 247*).

Influence of temperature and food on the respiratory quotient of molds, C. GERBER (*Compt. Rend., 124 (1897), No. 3, pp. 162–164*).

Soil inoculation with pure cultures of tubercle bacteria for the culture of legumes, F. NOBBE (*Tharand Forst. Jahrb., 46 (1896), II, pp. 248–275*).—The substance of this paper has already been given (E. S. R., 8, p. 469).

On the acclimation of different plants to the dunes of Medoc, P. BUFFAULT (*Rev. Eaux et Forêts, ser. 3, 1 (1897), No. 3, pp. 65–76*).

Some new fungi, chiefly from Alabama, L. M. UNDERWOOD (*Torrey Bul., 24 (1897), No. 2, pp. 81–86*).—Descriptions and critical notes are given of the following new species: *Hydnum chrysocomum, Lepiota mammæformis, Leptoglossum alabamense, Peronospora plantaginis, P. seymourii, Polyporus decurrens, P. earlei, P. flavosquamosus, P. irregularis, P. meliæ, P. retipes, Puccinia polysora,* and *Ustilago sparsa.*

Contributions to the Gasteromycetes of Maine, F. L. HARVEY (*Torrey Bul., 24 (1897), No. 2, pp. 71–74*).

Contributions to the Myxogasters of Maine, II, F. L. HARVEY (*Torrey Bul., 24 (1897), No. 2, pp. 65–71*).

New West American fungi, III, J. B. ELLIS and B. M. EVERHARDT (*Erythea, 5 (1897), No. 1, pp. 5–7*).—The following new species are described: *Asteridium bicolor, Homostigia rhoinum, Didymosporium rhoinum, Cercospora hyptidis, C. eriogoni, Puccinia serjaniæ, P. transformans,* and *Æcidium gossypii.*

Notes on West American Coniferæ, IV, J. G. LEMMON (*Erythea, 5 (1897), No. 2, pp. 22–25*).—Notes are given on the nomenclature of the Douglas spruce.

Descriptions of new Australian fungi, D. MCALPINE (*Proc. Linn. Soc. N. S. Wales, 21 (1896), No. 81, pp. 104–106, pls. 2*).—Descriptive notes are given of *Meliola fumerea, Cyathus plumbagineus,* and *Phoma stenospora.*

Contributions to the Queensland flora, F. M. BAILEY (*Queensland Dept. Agr., Botany Bul. 14, pp. 16, pls. 6*).—Descriptions and critical notes are given on additions to the flora of Queensland, and several new species are figured and described.

The botanical garden of the University, W. A. SETCHELL (*California Sta. Rpt. 1895, pp. 312–316*).—The present condition of the botanical garden and herbarium of the University is described and some suggestions are given as to future investigations.

METEOROLOGY.

Experiments on the prevention of night frosts, F. H. KING (*Wisconsin Sta. Rpt. 1895, pp. 253–267, figs. 6*).—These experiments were planned primarily to test the method for frost prevention proposed by S. Lemström, of Finland,[1] although in 5 out of the 6 trials reported other materials than the peat torches recommended by him were used. In 4 trials pint cups of kerosene were placed at intervals of 10 ft. over the area selected for the test and lighted. In 1 trial 80-pound piles of oak wood were burned at distances of 20 ft. around the margin of the area, while in the interior 8 other piles were placed in the form of a square 80 ft. apart and 80 ft. from the margin. In the experiment with the peat torches the directions of Lemström were followed. Ordinary and self-recording thermometers were placed in different positions inside and outside of the protected areas and their readings carefully noted.

[1] For description of details of this method see E. S. R., 5, p. 660.

The conclusions reached are as follows:

"While the several experiments here detailed agree in showing that torches placed and burned in the manner described did exert only a feeble influence on the temperature of thermometers within the protected areas, or none at all, yet the writer feels that these experiments do not warrant the conclusion that frost torches may not, at times, be used to advantage. They do demonstrate conclusively, however, that there are conditions under which they are of no avail.

"It must be remembered, however, that all of these trials except the first, when there was no frost, occurred at times either later in the season or earlier than they are likely ever to be needed. Now it may be shown that during these seasons the temperature of the air does not materially increase upward, and if this were true at the times of the experiments here recorded it is evident that the sucking of the layers of air up from the ground by the torches only helps to bring other air of the same or possibly lower temperature down upon it. In such a case only the smoke and cloud formed above the field could be effective in lessening the loss of heat by radiation.

"If, however, it is true that earlier in the fall and later in the spring, when destructive frosts do occur, the temperature of the air at night increases rapidly upward, then the influence of the torches might be much greater. But many trials similar to those here described need to be made at such times before the real value of torches and smudges in preventing damage by frost can be demonstrated."

An experimental rainfall, L. ERRERA (*Ciel et Terre, 17* (*1896*), *Aug., p. 353; abs. in U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24* (*1896*), *No. 10, pp. 373, 374*).—The method proposed is as follows: A cylinder of Bohemian glass about 20 cm. in height and 12 cm. in diameter is filled half full with strong alcohol (92 per cent), covered with a porcelain saucer, and warmed nearly to the boiling point over a water bath until the whole apparatus is in thermal equilibrium. It is then removed from the bath and, without agitating the liquid, placed upon a wooden table. After some minutes the porcelain cover cools and the vapors rising in the cylinder commence to condense in the form of distinct clouds. These condense into very fine drops, which fall steadily, vertically, and in countless numbers into the liquid. The drops were found to have an average diameter of from 0.04 to 0.05 mm., sometimes larger, but more frequently smaller. This interesting spectacle may last for half an hour. At first the vapors rise quite up to the porcelain cover, but as the apparatus cools the level of condensation naturally falls until a clear space is noted above the zone of clouds.

"The experiment has been repeated at the Weather Bureau with success, but it should be carried out on a large scale, with a very tall jar and great care as to uniformity of temperature, if one desires to get satisfactory results."

Instructions for taking phenological observations, L. H. BAILEY (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24* (*1896*), *No. 9, pp. 328–331*).—The author states that phenological observations are of two general types, those which simply record the external features of the passing life in plants and animals, and those which attempt to discover or construct some vital connection between life

events and climatal environments. The first is concerned chiefly with observations, and the other with experiments and philosophy. In the present paper it is the intention merely to indicate practical methods to be pursued in taking notes which shall have a permanent value.

The observer should take one or more of the following subjects, restricting himself to a definite line of inquiry: "To determine (1) the general oncoming of spring, (2) the fitful or variable features of spring, (3) the epoch of the full activity of the advancing season, (4) the active physiological epoch of the year, (5) the maturation of the season, (6) the oncoming of the decline of fall, (7) the approach of winter, (8) the features of the winter epoch, and (9) the fleeting or fugitive epochs of the year."

In selecting plants, those which are convenient for observation year by year, and which will give unequivocal periods, should be chosen. The author quotes Hoffmann's essentials of phenological observations[1] as follows:

"(1) As broad a distribution as possible of the given species selected for observation.

"(2) Ease and certainty of identifying the definite phases which are to be observed.

"(3) The utility of the observations as regards biological questions, such as the vegetative periods, time of ripening, etc.

"(4) Representation of the entire period of vegetation.

"(5) Consideration of those species which are found in almost all published observations, and especially of those whose development is not influenced by momentary or accidental circumstances."

In general, the events which determine the epochs should be observed upon a definite and well-chosen set of plants of limited number, and it is important that the dates should represent the average epoch and not the very first bloom or leaf upon some individual early plant. In choosing dates for record the scheme proposed by Hoffmann, which is essentially that of Linnaeus, is recommended, namely, (1) upper surface of the leaf first visible or spread open, (2) first blossom open, (3) first fruit ripe, (4) all leaves, or more than half of them, colored.

In choosing the plants for observation care must be taken to select typical average plants which are not unduly exposed either to heat or cold, moisture or dryness. The observer should always state whether the plant is in wild or cultivated grounds. The author considers it best to take notes upon 2 or 3 typical individuals and then average the results. The methods pursued by Hoffmann and other German phenologists are shown by quotations from their records.

The author suggests a list of plants upon which observations may be taken in this country. This list, which is not intended to be complete, embraces plants for observations in New England and New York, as follows: Apple, pear, quince, plum, sweet cherry, sour cherry, peach, chokecherry (*Prunus virginiana*), wild black cherry (*P. serotina*), Japanese or flowering quince (*Pyrus japonica*), cultivated raspberry,

[1] Phänologische Beobachtungen aus den Jahren 1879–'82.

blackberry, and strawberry, lilac, mock orange syringa (*Philadelphus coronarius*), horse chestnut, red pith elder (*Sambucus racemosa*), common elder (*S. canadensis*), flowering dogwood (*Cornus florida*), native basswood, native chestnut, privet or prim (*Ligustrum vulgare*), red currant, and cultivated grape.

In addition to the events to be recorded as mentioned by Hoffmann, the author thinks that there should probably be included the date of nearly complete defoliation for those species whose leaves color some time before they fall. All unusual flowering seasons should be recorded, but they should be distinctly marked so as not to be confounded with the normal events, and all sudden meteorological changes, as frosts in the fall and spring and high winds when defoliation takes place, should be observed.

In conclusion, it is stated that persons spending their summers at resorts on the mountains or elsewhere can make useful records, providing they visit the same place year after year. They can select a few typical plants, and observe their conditions at the time of their arrival and departure. At the same time they can make records of progress of harvests, of hay and grain, and other staple crops.

Climate of the Foothill Station, California, C. H. SHINN and G. HANSEN (*California Sta. Rpt. 1895, pp. 358–364, figs. 2*).—This station is located in the Sierra foothills, 5 miles northeast of Jackson, at an elevation of a little less than 2,000 ft. above sea level. General notes on observations on climatic phenomena since the establishment of the station are given, with a monthly summary of observations on temperature during 1894, 1893, and a part of 1892, on the top of the highest hill on the station farm and at a point in a valley about 200 ft. below.

"The Foothill Station does not possess a climate in any way remarkable as compared with numerous localities at similar elevations in the Sierras. It has what is better, a typical foothill situation, surrounded by peaks, ridges, and depressions of greater or less extent, giving it the general characteristics of a so-called 'thermal belt,' or thermal spot, thousands of which exist undescribed throughout California."

It appears that these thermal belts do not occur at a greater elevation than 2,000 ft. above sea level.

"The warm air travels from our valleys to the snow-capped Sierras, and the cold air moves from them to the lands below. The path which they travel is varied by every hill and curve in the cañons. . . .

"Along the cañons flows the cold heavy air from the Sierras, frost-killing whatever is in its path, if too tender for the season. If such cold stream of heavy air is too voluminous, it has to overflow into a side cañon. The space which these cold rivers occupy was previously held by warm air, which was lighter, and had to give way, rising above the level of the cold. Wherever it goes is the warm region, the thermal belt. . . .

"Thermal belts favor the farmer, because the season of growth is longer than elsewhere. While in early spring the sun warms the low places, and forces vegetation into growth, though it is apt to be frosted, the air in a thermal belt is circulating, and growth advances safely."

The greatest difference in temperature between day and night registered at the station in 5 years was 13° F. The lowest temperature recorded was 21° F.

The number of sunless days is rarely more than about 40 during the year, notwithstanding the fact that the rainfall is from 25 to 54 in. annually. Fogs do not originate at the station but come up from the valley, and snow is little known.

Meteorological observations at Berkeley, California, A. O. LEUSCHNER and F. H. SEARES (*California Sta. Rpt. 1895, p. 307*).—A synopsis of observations for 3 years ending June 30, 1895, on air pressure, temperature, precipitation, humidity, cloudiness, and direction of wind. The summary for the year ending June 30, 1895, is as follows:

Pressure (inches): Mean, 30.033; highest, 30.435 (Feb. 16); lowest, 29.432 (Jan. 16). *Temperature* (°F.): Mean of the year, 53.8; maximum, 93 (Aug. 26); minimum, 34 (Jan 24). *Precipitation* (inches): Total rainfall, 39.008; dew and fog, 0.077. *Humidity* (per cent): Maximum, 97 (Oct. 23, Jan. 8, Feb. 12); minimum, 36 (Dec. 12). *Weather:* Number of clear days, 215; number of fair days, 76; number of cloudy days, 74; number of foggy days, 95; number of days on which rain fell, 55.

Agricultural meteorology, F. MARIE-DAVY (*Jour. Agr. Prat., 61 (1897), I, No. 3, pp. 88-92*).—A summary for December and for the year 1896 of observations at Paris on temperature, pressure, humidity, cloudiness, and winds. The year was the wettest (705 mm. precipitation) in two centuries, 1804, with 703 mm., being the nearest approach to it during this period.

The origin of the stratus clouds and some suggested changes in the international methods of cloud measurement, J. H. CLAYTON (*Nature, 55 (1896), No. 1418, pp. 197, 198*).

Hoar frost especially rich in nitrogen, A. LANCASTER (*Ciel et Terre, 17 (1896), p. 54; abs. in U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24 (1896), No. 10, p. 371*).—Data obtained by Petermann and Graftiau at Gembloux are reported, which show that melted frost contains about 7.5 mg. of nitrogen per liter, and that the amount of nitrogen supplied to the soil by a single ordinary frost may amount to 7 lbs. per acre. In cases of heavy frost the amount is much greater.

Weather report for Perris, Riverside County, California (*California Sta. Rpt. 1895, p. 16*).—A tabulated daily summary of observations on temperature, rainfall, and casual phenomena for the 6 months ending March 31, 1895.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 24 (1896), Nos. 8-11, pp. 281-442, figs. 2, charts 24*).—Besides the usual summaries of observations, No. 8 contains special articles on experiments with kites at San Francisco, California, by W. H. Hammon, and on the heated term from July 28 to August 7, 1896, by H. A. Hazen; and notes by the editor on Mexican climatological data and periodicity of good and bad seasons.

No. 9 contains special articles on the wind rush of September 29, 1896, by H. A. Hazen; kite experiments at the Blue Hill meteorological observatory and a high kite ascension at Blue Hill, by S. P. Fergusson; instructions for taking phenological observations, by L. H. Bailey (see p. 672); progressive movement of thunderstorms, by A. J. Henry; low pressure in St. Louis tornado, by J. Baier; early experiments in atmospheric electricity, by C. E. West; and the International Meteorological Conference in Paris, by R. H. Scott; and notes by the editor on Espy and the Franklin kite club, isobars and their accuracy, the first attempt to measure wind force, and barogram near a hurricane center.

No. 10 contains special articles on the International Meteorological Conference at Paris, September 1896; and the International Hydrological, Climatological, and

Geological Conference at Clermont-Ferrand, by A. L. Rotch; horizontal atmospheric rolls, by F. W. Proctor; long-range seasonal predictions for Oregon, by B. S. Pague; and notes concerning the West India hurricane of September 29–30, 1896, by A. J. Henry; and notes by the editor on forms of clouds, hoar frost especially rich in nitrogen (see p. 675), atmospheric refractions at the surface of water, an experimental rainfall (see p. 672), Mexican climatological data, unreliable popular weather proverbs, the effect of shading the soil, and a prize for kite flyers.

No. 11 contains special articles on an endeavor to discover electrodynamic radiations from the sun, by J. Trowbridge; sunstroke weather of August, 1896, by W. F. R. Phillips; how the chinook came in 1896, by A. B. Coe; a method of filling a barometer, by E. B. Partridge; and the cold spell of November 16–30, 1896, in Montana and adjoining States, by H. A. Hazen; and notes by the editor on simultaneous balloon ascensions, the Franklin kite club, the use of the kite in meteorology, the upper currents of air above the Indian monsoon region, the origin of typhoons and hurricanes, the low areas of our Pacific Coast, high-level isobars, the Tennessee river and flood system, and Mexican climatological data.

Summary of solar observations at the Royal College of Rome during the second half of 1896, P. TACCHINI (*Compt. Rend., 124 (1897), No. 6, pp. 274–276*).

Meteorology, Island of Mauritius (*Rap. Ann. Sta. Agron. Île Maurice, 1895, pp. 1–7*).—Observations on atmospheric pressure, temperature, humidity, and precipitation during the year 1895 are recorded.

WATER—SOILS.

Investigations on the drainage water of different soils, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 3, pp. 212–223*).—In continuation of previous studies[1] the author observed that increasing the surface of the soil by ridging decreased the amount of drainage, while loosening the surface soil increased it. Observations on the amount of drainage water flowing from peat, loam, calcareous sand, humus-calcareous sand, and quartz sand are reported. From the data given it is estimated that the rate of flow of drainage water from the finest grained soil was 0.8 liter (0.68 pint per acre) per second per hectare.

Investigations on the relation of atmospheric precipitation to plants and soils, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 3, p. 267*).—This article is a general discussion of the influence of precipitation on the chemical properties of the soil and reviews briefly the work of various investigators in this line. Data of the nitrogen content of rain water in different parts of the world are tabulated. These lead to the conclusion that only in populous centers is the nitrogen of the rain water sufficient to exert any appreciable influence on the growth of plants. While the nitrogen is present in many forms, there is more ammoniacal nitrogen than nitric nitrogen. In manufacturing centers the sulphuric acid brought down in the precipitation may cause decided injury to plants.

The amount of chlorin and other constituents which the rain brings to the soil are also discussed, as well as the influence of precipitation

[1] Forsch. Geb. agr. Phys., 7 (1888), p. 46.

upon the decomposition of the organic matter of the soil and upon the movement and distribution of the soluble constituents of the soil.

The injury caused by the leaching of the soil by long periods of rainfall and by concentration of soluble salts at the surface of the soil by long periods of drought are noted, and the influence of plant cover in mitigating this are pointed out.

The distribution of the salts in alkali soils, E. W. HILGARD and R. H. LOUGHRIDGE (*California Sta. Rpt. 1895, pp. 37–69, dgms. 8*).—The main points of this article have already been published,[1] the detailed data being given here in tables and diagrams. The article is based on observations and experiments at the Tulare Substation. The topics discussed are natural conditions of the land, the questions to be solved, the effect of rainfall and irrigation, effect of application of gypsum, effect of cropping, percentage composition and total amounts of salts in the different soils, black and white alkali, counteracting evaporation, and Australian saltbush on alkali soils.

It is shown that there is an accumulation of alkali in the soil at a depth of about 3 ft., due to the fact that rainfall in regions where alkali occurs rarely wets the soil to a greater depth than this. Where irrigation is practiced the evaporation of the water causes the alkali to rise toward the surface. The bulk of the alkali salts is therefore accumulated within easy reach of the surface and of underdrains, and if once removed there is little danger that a sufficient amount of it to do any harm will again come from below.

"[Applications of 1½ tons per acre of gypsum were made during 1894 and 1895 to an alkali spot] with the result that while in 1893 scarcely a blade of the barley sown matured seed, in 1894 (a very dry season) about half the land bore barley hay at the rate of a ton per acre, growing 2 ft. high, and maturing seed where allowed to stand. In 1895 the reclamation had progressed nearly 100 ft. farther east in the direction of the original spot. The barley sown refused to germinate only within the limits of that spot, but on the rest of the tract was 2 ft. high in March, and 4 ft. in May, the land yielding hay at the rate of 2½ tons per acre. The line between the reclaimed and unreclaimed land was very sharp, so that the luxuriant crop and the bare surface were at times within 5 ft. of each other, with a narrow band of etiolated grain between."

An examination of the soil so treated indicates "that in a sandy loam, in which the upper 3 in. contain, at the end of the dry season, not over 1.4 per cent of alkali, consisting chiefly of Glauber's salt (sulphate of soda), barley can be made to yield a fair crop."

"It is evident, from the facts given, that for barley the limit of toleration consistent with a full hay crop, under otherwise favorable conditions, and with salts consisting of not over one-half of carbonate of soda, lies somewhere between 25,500 and 32,000 lbs. per acre, in round numbers, within the first 4 ft. of soil and subsoil; always provided, that the layer so limited contains substantially all the salts likely to come within reach of surface evaporation. Expressed in percentages of the soil and subsoil mass itself, this indicates, respectively, 0.159 and 0.203. . . .

[1]U. S. Dept. Agr., Office of Experiment Stations Bul. 30, p. 66 (E. S. R., 7, p. 173); U. S. Dept. Agr. Yearbook 1895, p. 103.

"Should the percentage of total salts in the soil not materially exceed the lower of the above figures (perhaps up to the limit of 0.175 per cent), nor the carbonate percentage one-half of the above, we may consider that, for barley at least, the land can be reclaimed by simply treating with gypsum, and deep and thorough culture; while any land of which the salt content, ascertained by the same method, falls materially below the above figure, may be confidently taken into cultivation, even when covered with alkali grass.

"The limits of tolerance for other culture plants doubtless differ greatly, and have to be separately ascertained for each one. . . .

"The saltbush came up easily from seed on land of which the surface foot contained one-third per cent of salts, but languished, although they did not die, when that amount reached one-half per cent; the surface foot then containing not less than 31,000 lbs. of total salts per acre. Where the surface crust (including about half an inch of the surface soil) contained nearly 8 per cent of total salts, of which one-half was Glauber's salt, the rest almost evenly divided between the carbonate and common salt, the young plants of saltbush scarcely kept alive; they died when the accumulation rose to over 25 per cent in the first half inch, 0.6 being Glauber's salt and 0.15 carbonate of soda; a weakness which, under the circumstances, must be considered pardonable."

The charts and tabulated data given show that the proportion of carbonate of soda (black alkali) decreases as the surface of the soil is approached, and confirms the conclusion "that whenever an alkali soil is subjected to the action of stagnant water or of abundant moisture without aëration, the formation of black alkali will take place."

Investigation of matière noire, or humus, M. E. JAFFA (*California Sta. Rpt. 1895, pp. 35, 36*).—The method used by the station in determining humus and nitrogen in humus in soils is as follows:

"Two portions of 5 or 10 gm. of air-dried soil (depending on richness in humus) are weighed off into prepared filters (about 9 cm.). The soils should be covered with filter paper, so as to prevent packing when solvents are poured on them.

"They are now treated with dilute hydrochloric acid, from 0.5 to 1 per cent strength (25 cc. concentrated acid to about 800 cc. water), to dissolve out the lime and magnesia, which prevent the humus from going into solution with alkali hydrates. The treatment with acid is continued until there is no reaction for lime; the acid is then washed out with water to neutral reaction. The funnels (7 cm.) containing the washed soils are now stoppered (either with a cork or by means of a small piece of rubber tubing with glass plug), and one of them is treated with ammonia water 6 to 7 per cent strong, for the determination of humus, and the other with potassium hydrate 5 per cent strong, or sodium hydrate 4 per cent, for the estimation of the nitrogen. The mode of operation is the same in both cases, so far as the extraction of the humus is concerned. The lye, ammonic or potassic, is poured on the respective funnels and allowed to remain a few hours. (If started late in the afternoon, the liquid can remain in the funnel all night.) The solution is then allowed to pass through, and the filter washed once with the lye; the funnel is then restoppered and a fresh quantity of the solvent added to the filter. This treatment is repeated until the filtrate remains colorless.

"The ammonia solution, or an aliquot of the same, is evaporated in a weighed platinum dish, over the water bath, and the residue dried at 100° C., and weighed. It is then ignited and reweighed; the loss in weight shows the amount of humus. It is rarely necessary to recarbonate the ash.

"The potassium or sodium hydrate solution[1] is measured, and if much over 100 cc. is

[1] Sodium hydrate is preferable to potassium, as sodium sulphate (formed in the flask) is less liable, owing to its greater solubility, to "bump" during the boiling down with sulphuric acid, and the subsequent oxidation.

best divided into 2 equal parts; if over 200 cc., into 3 equal parts, etc., adding water if necessary, to render aliquoting simple. We now take one-half or one-third, etc., as the case may be, and transfer to Kjeldahl flask, acidify with pure concentrated sulphuric acid, and boil down until nearly all the water has been evaporated. The flask is then cooled, and sufficient sulphuric acid and mercuric oxid are added to determine the nitrogen in the usual way by the Kjeldahl method. In the distillation, 10 to 20 cc. tenth normal hydrochloric acid is used in the receiver with methyl orange as an indicator.

"Each cubic centimeter of acid used is equivalent to 0.0014 gm. of nitrogen. The percentage of nitrogen in the soil calculated on the percentage of humus in the soil gives the nitrogen in humus."

Analyses of waters (*California Sta. Rpt. 1895, pp. 92–111*).—Sanitary and mineral analyses of 49 samples of stream, lake, spring, and well waters.

Naturally faulty lands and their correction, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 114–118*).—Unproductiveness due to hardpan and dry sandy surface soil is discussed, and means of overcoming it are explained.

Perris Valley, Riverside County, California (*California Sta. Rpt. 1895, pp. 15–21*).—Notes on the soil and climatic conditions of this region, and tabulated analyses of soils and well waters of the region.

A study of the Oxford soils of the southern part of the province of Oran C. BRIOUX (*Ann. Agron., 23 (1897), No. 1, pp. 42–46*).

Experiments on the water capacity of the soil (*Deut. landw. Presse, 23 (1896), No. 102, p. 910*).

The state of tension of water and air in the soil, H. PUCHNER (*Forsch. Geb. agr. Phys., 19 (1896), No. 1–2, pp. 1–19*).

Humus and soil fertility, H. SNYDER (*Ann. Agron., 22 (1896), No. 12, pp. 531–564*).—Translated from U. S. Dept. Agr. Yearbook 1895, p. 131, by Marcille.

The supply of soil nitrogen, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 32–35*).—A popular discussion of the sources and means of conserving and increasing the supply of nitrogen in the soil. The importance of green manuring is pointed out and attention is called to a foreign leguminous plant, *Tetragonolobus purpureus*, for which the name square-pod pea is proposed. The station has tested this plant to some extent and it appears to be well adapted to California conditions. The richness of the humus of arid regions in nitrogen and the presence of nitrates in alkali are also noted.

The acidity of upland soils, H. J. WHEELER ET AL (*Ann. Agron., 22 (1896), No. 12, pp. 564–570*).—Translated from Rhode Island Station Report for 1895, by E. Demoussy.

Analyses of specimens of alkali (*California Sta. Rpt. 1895, pp. 69–71*).—The results of examinations of 11 samples are reported.

Rocks, clays, marls, coals, and plants (*California Sta. Rpt. 1895, pp. 112, 113*).—A list of such materials sent to the station for identification.

Examination of soils (*California Sta. Rpt. 1895, pp. 13–23*).—Mechanical and chemical analyses are given of 4 samples of soil from Perris Valley, 1 from Ventura County, and 1 from Hollister, with a list of samples sent to the station for examination.

Late progress in soil examination, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 23–32, pl. 1*).—This paper was read before the Association of American Agricultural Colleges and Experiment Stations at Denver, Colorado, August, 1895 (E. S. R., 7, p. 178).

FERTILIZERS.

The fertilization of land, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 123–135*).—A table shows the draft of different crops on the fertility of the soil, and the general principles of manuring are discussed with special application to California conditions.

A study of the soils of California with a view to determining their fertilizer requirements leads to the following general conclusions:

"(1) Apart from the regions of abundant rainfall in the higher Sierra foothills and in northern California, and a few local exceptions, all the soils of the State contain as much lime as is useful in soils. In almost all cases a considerable excess of the carbonate is present, so as to insure the absence of acidity, even in lowlands where it would be expected to occur.

"(2) The same is almost as generally true as regards potash. The amounts present are, in the great majority of cases, so far in excess of the average found in the soils of Europe and of the East that the experience of those countries can not serve as a guide in considering the requirements of our soils. Throughout the valley lands proper of the Great Valley, as well as that in southern California and in the valleys of the Coast Ranges as far north as Mendocino, the soil water carries such large amounts of potash salts (in the alkali lands often as much as 1,000 lbs. per acre) that to add more in fertilization would be sheer folly. While in the uplands adjacent the drainage toward the valleys prevents such accumulation, the fact that such drainage water carries the same salts is easily verified, and is apparent from examination of the stream waters as well. It is therefore reasonable to conclude that in the great majority of California soils potash will be the last one of the 3 ingredients usually supplied in fertilizers, that need be purchased by the farmer.

"It should be added that the same rules as regards lime and potash hold good of the greater part of the region lying between the Pacific and the Rocky Mountains, excepting the humid coast belt of Oregon and Washington; the cause being the universal one, that in all regions of deficient rainfall the lime and potash that in the rainy countries are currently washed out into the country drainage are partially or wholly retained in the soils.

"(3) No such rule, however, applies to phosphoric acid, because of its difficult solubility under ordinary soil conditions. Its presence in greater or less amounts depends entirely upon the kind of rocks from which the soil is derived. It happens that in California most of the rocks—and, therefore, the soils derived from them—are poor in phosphates, contrary to what happens in eastern Washington and Montana. Hence phosphates are among the first ingredients to become deficient in California soils, as has been amply proved by actual experience of farmers in whose hands superphosphates and phosphatic guanos have become the favorite fertilizers from the first. Exceptions occur in the case of 'black alkali' soils, in which soluble phosphates frequently circulate just as do the potash salts.

"(4) As regards nitrogen, the most costly of all the ingredients usually supplied in fertilizers, its average total amount in the soils of the arid or irrigation regions is apparently less than is usually the case in the countries of summer rains. On the other hand, the conditions for rendering it available to plants are much more favorable, and the chances of waste by washing out very much less, save in case of excessive irrigation. So far as our observations go, it is likely to become deficient next in order to phosphoric acid under normal conditions, and should be supplied whenever the superphosphates fail to produce satisfactory results. In alkali soils, however, it occurs so constantly and abundantly in the form of saltpeter as to be in excess at times; in these, therefore, the use of nitrogenous fertilizers will, as a rule, be useless, at least for a number of years. . . .

"The one ingredient of which a surplus is rarely found, especially in the soluble condition, is phosphoric acid; and to supply it in an efficacious, easily soluble form is usually the most probable remedy indicated, when deficiency of plant-food makes itself felt in this State."

The relative merits of different fertilizing materials are briefly discussed.

On the composition and agricultural value of Thomas slag, G. PATUREL (*Ann. Agron., 22 (1896), No. 11, pp. 497–515; Bul. Soc. Chim. Paris, 17–18 (1897), No. 5, pp. 319–321.*—The author gives a comprehensive report on his own work and that of other investigators in this line. The principal results are briefly summarized as follows:

(1) The use of slag is increasing in France and is attended with great benefit to all kinds of crops on account of the phosphoric acid and lime which it contains.

(2) The chemical composition of slag has been much discussed recently. In Germany Hilgenstock and Otto have arrived at the conclusion that it is composed of tetracalcium-phosphate and calcium silicate with an excess of free lime. This has been denied by French chemists, particularly Haneuse and Souris, who claim that it is tricalcium phosphate and phosphate of iron.

(3) Analyses by the author of 5 samples of slag commonly used in France showed 14 to 19 per cent of phosphoric acid and 41 to 52 per cent of lime. The proportions of phosphoric acid, silica, and lime, calculated from these analyses (deducting the amount of lime which is in the free state in the slag) confirm the hypothesis of the German chemists as to the chemical constitution of slag.

(4) The free lime in the slag is difficultly soluble in chemical reagents on account of the high temperature to which the slag has been submitted. It is nevertheless possible to determine it by digestion of the slag in ammonium chlorid, which dissolves the lime completely without attacking either the silicate or phosphate.

(5) The method proposed by Wagner for determining the agricultural value of slags did not give satisfactory results on account of the free citric acid in the reagent. The quantity of phosphoric acid dissolved varied widely with the method of manipulation and with the content of free lime.

(6) By prolonged digestion of extremely finely powdered slag in normal alkaline amonium citrate more than four-fifths of the phosphoric acid was dissolved. This result is in accord with the well-known effect of slag as fertilizer and is an additional indication that it does not contain tricalcium phosphate. Crude phosphates treated in the same manner did not give a trace of phosphoric acid.

(7) Slags exert a very active influence upon nitrification of nitrogenous matter in acid soils. The amount of nitrates formed increases with the proportion of slag used. Since this action is due to the free lime which the slag contains it follows that with an equal content of phosphoric acid that slag will be most effective in acid soils which contains

the largest amount of uncombined lime. The determination of this constituent in slags is therefore of the greatest importance.

The geology of nitrate formation from the standpoint of bacteriological chemistry, A. PLAGEMANN (*Geologischer über Salpeterbildung vom Standpunkt der Gährungschemie. Hamburg: G. W. Seitz*).—This is a brochure discussing from personal observations the formation of the nitrate deposits of western South America.

The formation of phosphate deposits, A. CARNOT (*Echo des Mines, 32 (1896), p. 975; abs. in Chem. Ztg., 21 (1896), No. 3, Repert., p. 6*).

Theory of the sedimentary phosphorites, S. MEUNIER (*Ann. Agron., 23 (1897), No. 1, pp. 5–27*).

Experiments with peat and excrement mixture and with barnyard manure, TANCRÉ (*Landw. Wochenbl. Schles. Holst., 47 (1897), No. 5, pp. 91–94*).

Means of preventing the loss of nitrogen in manure (*Prog. Agr. et Vit., 21 (1897), No. 4, pp. 89, 90*).

Crops for green manuring, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 118–123, pls. 4*).—The objects of green manuring are explained and the adaptability of different classes of plants to this purpose is discussed. Plates show the root systems of blue grass, square-pod pea (*Tetragonolobus purpureus*), snail clover, and black acacia, the last 3 illustrating especially the root tubercles of leguminous plants.

The relative value of green and dry vegetation for plowing in, and of green manuring and stable manure is also discussed.

Tests of chemical fertilizers in 1896, C. DUSSERE (*Chron. Agr. Cant. Vaud, 10 (1897), No. 3, pp. 69–73*).

Analyses of fertilizers, gypsum, etc., E. W. HILGARD (*California Sta. Rpt. 1895, pp. 135–139*).—Partial or complete analyses are reported of 10 samples of fertilizing materials, including mixed fertilizers, sulphate of potash, bird guano, ostrich manure, lime refuse, and 16 samples of gypsum.

Analyses of commercial fertilizers, H. J. WHEELER, B. L. HARTWELL, and C. L. SARGENT (*Rhode Island Sta. Bul. 39, pp. 61–68*).—A schedule of trade values of fertilizing materials and notes on valuation are given, with tabulated analyses and valuations of 41 samples of fertilizers.

Analyses of commercial fertilizers, T. J. EDGE and W. FREAR (*Pennsylvania Dept. Agr. Bul. 19, pp. 39*).—This includes the text of the State fertilizer law, notes on valuation, and tabulated analyses and valuations of 588 samples of fertilizers examined during the year ending December 31, 1896.

FIELD CROPS.

Conditions affecting the starch content of potatoes, E. S. GOFF (*Wisconsin Sta. Rpt. 1895, pp. 317–331*).—In this article the author considers the variation in starch content in different varieties, in different seasons, and between different specimens of the same variety; the influence on the starch content of heredity, the depth at which the tubers grow in the soil, distance in planting, climate, greening, scabbiness, and size; also the distribution of starch within the potato tuber, and the relation of starch content to cooking quality. The specific gravity of the tubers was used as a measure of their starch content. Tabulated data are given under the different divisions of the subject. The author concludes as follows:

"(1) Different varieties of the potato, grown under the same cultural conditions, may vary in their food value to the extent of one-half or more.

"(2) The starch content of the same variety and on the same soil may vary considerably in different seasons.

"(3) Different tubers of the same variety, grown under similar cultural conditions, may vary in their starch content to the extent of one-third or more.

"(4) This difference does not appear to be a result of heredity.

"(5) Pronged tubers are inferior in their starch content to regular ones.

"(6) The tubers that grow deepest in the soil are richest in starch.

"(7) In one trial the hilling of potatoes apparently caused a reduction in their starch content.

"(8) Potatoes grown rather closely in drills were richer in starch than those grown in rows both ways.

"(9) Potatoes greened by exposure to sunlight and those that are very scabby are not necessarily poorer in starch than others.

"(10) No relation was apparent between the size of tubers and their starch content.

"(11) The higher the starch content the sooner a potato cooks and the more it swells in cooking.

"(12) The flavor of potatoes is not necessarily dependent upon their starch content."

The author suggests that the market price of potatoes should be based upon their starch content rather than upon their bulk, and describes an apparatus suitable for the rapid grading of potatoes in order to determine their market value on this basis.

The growing of sugar beets on alkali soils, E. W. HILGARD and R. H. LOUGHRIDGE (*California Sta. Rpt. 1895, pp. 71–91, pl. 1*).—These experiments were carried out upon a 10-acre tract of land at Chino, located on the borders of the alkali land. The field was first cultivated and planted with forage plants, but none of them gave promise of a crop, so the greater part of the tract was again plowed, and on May 29 was sown to sugar beets. "These came up quickly, though with a somewhat thin stand, right among the alkali efflorescences, and continued to grow without let or hindrance." Owing to the wide differences in composition of leachings from different parts of the tract, it was found necessary to discriminate between the different portions, and the entire area was divided into plats 50 ft. square. Chemical and physical analyses of the soil, composition of the leachings from soils of 66 plats in different portions of the tract, and of leachings from samples taken from different depths on 3 plats, crop data and composition of beets grown on 6 plats, and classification of beets by varieties and plats according to sugar content, are shown in tables and charts, and are discussed.

In some of the plats the alkali was of the "blackest" kind, containing over 2,000 lbs. of sodium carbonate per acre, while in others not far distant the alkali was "white," consisting of neutral salts. Sodium sulphate predominates in the tract as a whole, and common salt is mostly quite subordinate. "The most remarkable feature is the almost universal presence of nitrates, sometimes to the extent of over one-half of the total salt. . . . In some cases the total amount of saltpeter in the soil . . . is such as to exceed, many times, any fertilizing application ever made."

Beets grown on soil containing such an excess of nitrates were useless for sugar making, being overgrown and sappy and low in sugar

content. Some of them weighed 2.5 lbs. and yielded only 10 per cent of sugar in the juice, with a purity coëfficient of 67; while the general average weight elsewhere was less than 0.9 lb., with an average sugar content of 15.5 per cent, and purity between 85 and 90.

The author draws the following conclusions from the results:

"Sugar beets of good and even high grade, both as to sugar and purity, may be grown on lands containing as much as 12,000 lbs. of alkali salts per acre to the depth of 3 ft.; provided, that the percentage of common salt in the soil does not exceed an average of 0.04 per cent, or 1,500 lbs., per acre. . . .

"As regards the carbonate, inasmuch as it is easily convertible into sulphate by means of gypsum, the figure for its maximum tolerance is not of first importance; but so far as our experiments go, it seems to lie near 0.076 per cent, or 3,000 lbs., per acre for the first foot—implying probably about 4,000 lbs. for the first 3 or 4 ft. Within the limits of our experience at Chino the carbonates do not appear to be more injurious to the quality of the roots than the sulphates, and not near as much as the chlorids (common salt).

"As regards the sulphates, the maximum amount found to be present at any point where good beets were obtained was 0.179 per cent of the soil, or 7,200 lbs. per acre in the first foot—implying, for the total depth of 3 ft., about one-fourth more, or a total of 9,000 lbs. per acre. . . .

"These results emphasize the importance of ascertaining the total of salts present in the soil stratum of 3 to 4 ft., which may ultimately rise to the surface under cultivation or irrigation; and this is the more important because, as the present example shows, the texture of the soil may cause so great a difference in the appearance of the surface efflorescences, that lands perfectly capable of being profitably cultivated may, to the eye, be too heavily impregnated for that purpose."

Experiments with mineral fertilizers upon sugar beets in 1895, A. VIVIER (*Ann. Sci. Agron., ser. 2, 2 (1896), I, No. 3, pp. 374–384*).—These experiments were made upon 12 10-are (119.6 sq. yd.) plats. The general history of the field for 14 years and detailed data of fertilizers applied and crops produced for each year since 1887, the composition of the soil, and meteorological data are given. The fertilizers used were applied at the following rates: Nitrate of soda, 800, 600, 400, and 200 kg. per hectare; superphosphate 1,000, 700, and 400 kg.; and muriate of potash, 250 and 150 kg. One plat of each group received no application of the special fertilizer tested, but with others of the group was given a medium application of the other two fertilizers. All the plats received barnyard manure at the rate of 35,000 kg. per hectare. The beets were counted when pulled, weighed, and samples analyzed; and tables are given showing for each plat the total weight of crop, mean weight of roots harvested and analyzed, density of juice, quotient of purity, saline coëfficient, and sugar per deciliter and per hectare.

From the results of the year and preceding experiments in the same line, the author concludes that the crop increases with increased application of nitrate of soda and the density of the juice decreases at about the same ratio, so that the amount of sugar is not materially altered; and that applications of phosphoric acid show little effect upon either weight of crop or density of juice. The plats receiving

muriate of potash showed such irregularities in yield that it was unsafe to give conclusions.

Comparative trial of nitrate of soda and sulphate of ammonia with barnyard manure for sugar beets, A. VIVIER (*Ann. Sci. Agron., ser. 2, 2 (1896), I, No. 3, pp. 384–386*).—On 5-are (598 sq. yd.) plats, nitrate of soda and sulphate of ammonia were applied at rates equivalent to 30 and 60 kg. of nitrogen per hectare. In addition each plat received at the rate of 35,000 kg. of barnyard manure, 400 kg. of superphosphate, and 200 kg. of plaster per hectare.

While the nature of the nitrogenous fertilizer did not noticeably affect the yield, sulphate of ammonia gave a juice of much greater density than nitrate of soda.

Experiments in the culture and curing of tobacco, E. S. GOFF (*Wisconsin Sta. Rpt. 1895, pp. 311–316*).—This is a continuation of work published in the Annual Report of the station for 1894 (E. S. R., 8, p. 303).

Influence of distance in planting on the yield and thickness of the leaf (pp. 311–313).—Plants of the Wilson hybrid variety were set at distances of 1 by 1, 1 by 1½, and 1½ by 2½ ft. The results are tabulated. The author states that with the closeness of planting the yield increased, the size and thickness of the leaves diminished, and the percentage of fillers increased.

"Judging from the experiments of the past 2 seasons, no reason is apparent why the growers of the Spanish or Wilson Hybrid tobacco in Wisconsin should not set their plants in rows as near together as is consistent with convenience in cultivation, and as near as 1 ft. apart in the row."

Influence of the time of harvesting tobacco upon the yield and thickness of the leaf (pp. 313, 314).—Between August 24 and September 2 from tobacco topped August 6, upper leaves were picked and weighed daily. These were cured on wire lath in the curing house, all taken down at once, the leaves weighed separately, and the comparative thickness determined. The results are tabulated. The author says: "The tendency of the leaf to become thick as the time after topping increases is manifest to the extent of something over 6 sq. ft. of surface to the pound in favor of the leaves from the earliest topped plants as compared with the latest;" also in regard to further tabulated data obtained from portions of the main crop, "It is evident that in this trial the thickness and dry matter of the leaf tended to increase up to 32 days after topping. The yield also showed a tendency to increase in like manner."

A repetition of the curing experiments of 1894 (pp. 315, 316).—The recommendations given in 1894 are briefly as follows:

"Hang the tobacco moderately close, using care to so distribute the plants on the laths that no open spaces or flues will be left for the ready ascent of air from the bottom of the building to the top, and then so regulate the ventilation with the aid

of a psychrometer hung between the plants that the wet bulb shows a depression below the dry one of not less than 1 or more than 2°, using fire heat when necessary to accomplish this object."

This year's results confirm those of 1894. The author recommends a minimum depression of 1½° of the wet bulb thermometer instead of 1°, to provide a wider margin between the safety and danger limits.

The necessary loss of dry matter in corn silage, F. H. KING (*Wisconsin Sta. Rpt. 1895, pp. 273–278*).—The difference between the amount of silage put in and taken out, the computed loss of dry matter, the amount of spoiled silage, and the dry matter it contained are given for the years 1893 and 1894. The loss of dry matter is given as 4.95 per cent for 1893 and 9.38 per cent for 1894. The difference in the results for the 2 years is ascribed to the corn being put in drier in 1893 than in 1894, to much later opening of the silo in 1894, and to difference in the size of samples taken for analysis in the 2 years.

The loss of the dry matter in the ears of corn was tested on a sample of 40 lbs., one-half of which was put in the silo and one-half taken for analysis. There was a loss of dry matter of 1.15 per cent. Pieces of corn, stalks, and leaves were also cut in halves and put in 2 sets of 3 loosely covered Mason cans; 3 were placed in the silo, the other 3 taken for analysis. The losses in dry matter of the ear, stalks, and leaves are given at 4.90, 9.2, and 7.53 per cent, respectively.

"It thus appears from a consideration of all the data here presented that the necessary loss of dry matter in corn silage is considerably less than 10 per cent and is probably as low as 5 to 8 per cent. If this proves to be the fact it is a very important matter indeed, because if well-built silos and a proper handling of silage can reduce the loss from 10 to 15 per cent below what has been reported as the average, such a saving is a large addition to the profits of a farm wherever 100 or more tons of silage are put up."

Description of the principal varieties of fodder beets, H. L. DE VILMORIN (*Jour. Agr. Prat., 61 (1897), I, No. 6, pp. 207–212, pl. 1*).—Description of 19 varieties.

Trials of varieties of fodder beets, A. JORDAN (*Chron. Agr. Cant. Vaud, 10 (1897), No. 3, pp. 75, 76*).

Notes on cañaigre examination, C. E. COLBY (*California Sta. Rpt. 1895, p. 194*).—Roots were finely ground, repeatedly pressed, and extracted with water warmed to 132° F. The liquid extract was strained through fine linen, evaporated, and dried at 132° F. The air-dried extract is nearly all soluble in warm water and contains 75.02 per cent of tannin. The "spent" cañaigre still contained considerable tannin, so the author estimates that this method of extraction involves a loss of 13.4 per cent of the total tannin of the fresh root. A comparison of the hide powder, gelatin, and Neubauer-Lowenthal or permanganate methods indicated that all are safe methods to use.

The cañaigre, or tanner's dock, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 186–193*).—Revised from Bulletin 105 of the station (E. S. R., 6, p. 715).

Wild chicory and its culture, L. LIZIN (*Belg. Hort. et Agr., 9 (1897), No. 1, p. 5*).

Cultural value of red clover from seed of various origins, STREBEL (*Würt. Wochenbl. Landw., 1897, No. 1, pp. 1, 2*).—Comparison made at Hohenheim of French, Russian, and German seed.

Coffee culture, M. FESCA (*Jour. Landw., 25 (1897), No. 1, pp. 13–41*).

The cotton plant: Its history, botany, chemistry, culture, enemies, and uses (*U. S. Dept. Agr., Office of Experiment Stations Bul. 33, pp. 433, pls. 4, figs. 32*).—This

bulletin discusses the plant in its agricultural bearings only, no attempt being made to consider the problems of cotton manufacture. It includes the following articles: Introduction, by C. W. Dabney, jr.; History and general statistics of cotton, by R. B. Handy; Botany of cotton, by W. H. Evans; Chemistry of cotton, by J. B. McBryde and W. H. Beal; Climatology and soils, by Milton Whitney; The manuring of cotton, by H. C. White; Cultivated varieties of cotton, by S. M. Tracy; Culture of cotton, by Harry Hammond; Experiments in cotton culture by the experiment stations; Diseases of cotton, by G. F. Atkinson; The insects which affect the cotton plant in the United States, by L. O. Howard; The handling and uses of cotton, by Harry Hammond; The feeding value of cotton-seed products, by B. W. Kilgore.

The accessible literature upon the subject has been carefully searched by the writers of the different chapters, and an attempt made to embody in the bulletin the most important facts found in general treatises, special articles, and experiment-station publications. Quite complete references to the original sources of information are given in foot notes, and a supplemental bibliography is given containing a list of works which are not referred to in the body of the bulletin.

"On many topics long search has revealed a surprising paucity of reliable information. It is evident that thus far very few careful investigations of the cotton plant have been made. A great field of research remains open to our agricultural experiment stations, on which they have hardly begun to enter. When we consider how vast are the interests involved in the cotton industry, we realize the total inadequacy of the efforts thus far put forth to solve the perplexing problems confronting the cotton planter. This bulletin will have served an important purpose if it calls attention to the need of more thorough investigation of these problems and stimulates useful inquiries in this direction."

Chufas or grass nuts (*Florida Agr., 24 (1897), No. 8, pp. 113, 114*).—Popular description and directions for culture.

Report on certain Indian fibers, F. M. ABLE (*Agl. Ledger Calcutta, 1896, No. 6; abs. in Bot. Centbl., 69 (1897), No. 1, p. 28*).—Chemical studies were made of the fibers of *Hibiscus abelmochus*, *Malachra capitata*, and *Abroma augusta*, and the results tabulated.

Effect of continuous cropping upon the productiveness of flax and peas, STREBEL (*Würt. Wochenbl. Landw., 1897, No. 1, pp. 3, 4*).

Forage plants, E. J. WICKSON (*California Sta. Rpt. 1895, pp. 319–333, pls. 5*).—Brief notes are given upon the following forage plants distributed by the station with reports upon their growth by voluntary experimenters in different parts of the State: Saltbush (*Atriplex semibaccatum* and *A. leptocarpa*), sachaline, tagasaste (*Cytisus proliferus albus*), *Sida elliottii*, cowpea, flat pea, Jerusalem artichokes, square-pod pea (*Lotus tetragonolobus*), snail clover *Medicago turbinata*), crimson clover, tall oat grass, Texas blue grass (*Poa arachnifera*), Hungarian brome grass, Schrader's brome grass, Japanese wheat grass (*Agropyrum japonicum*), *Milium multiflorum*, Johnson grass, Kafir corn, esparcet, Jersey kale, and buckeye.

Tests of new grain varieties, N. WESTERMEIER (*Deut. landw. Presse, 24 (1897), Nos. 10, p. 79; 11, pp. 86, 87; 12, p. 98*).—Details are given of trials made at Kloster Hadmersleben in 1896 with 6 varieties of spring wheat, 8 of barley, and 9 of oats.

Useful and ornamental grasses, F. LAMSON-SCRIBNER (*U. S. Dept. Agr., Division of Agrostology Bul. 3, pp. 119, figs. 89*).—This bulletin aims to give an account of those characters and qualities of the more important grasses with which "one must become familiar in order to direct his efforts intelligently in the improvement of the forage and grazing resources of the country." It includes a list classifying the different grasses according to their uses, descriptions of the different species arranged alphabetically according to scientific names, and an alphabetical list of the common English or local names which serves as an index to the descriptions. About 370 species are described and many of them are illustrated by original cuts showing general characteristics.

Report on the hay crop at the Foothill Station, G. HANSEN and C. H. SHINN (*California Sta. Rpt. 1895, pp. 365–370*).—Barley and oats were grown for hay upon "granite" and "red" soils with different fertilizers. Nitrogenous fertilizers proved highly profitable upon the granite soil. The red soil was exceedingly variable in composition so that the results were inconclusive, but on certain plats nitrate gave a largely increased yield.

Treating wornout wet meadows, A. A. SOUTHWICK (*Amer. Agr.* (*middle ed.*), *59* (*1897*), *No. 9, p. 258*).

The introduction of the potato into Europe, J. BAYER (*Rev. Sci., ser. 4, 7* (*1897*), *No. 8, pp. 251, 252*).

Concerning the potato, L. VANDENBERCH (*Belg. Hort. et Agr., 9* (*1897*), *Nos. 3, pp. 39, 40; 4, pp. 55, 56*).

Cold frame culture of potatoes, C. GROSDEMANGE (*Rev. Hort., 69* (*1897*), *No. 3, pp. 63, 64*).

Experiments in potato culture, E. MARRE (*Prog. Agr. et Vit., 27* (*1897*), *No. 4, pp. 105–108*).

Distance experiments in potato planting, N. WESTERMEIER (*Fühling's landw. Ztg., 46* (*1897*), *No. 2, pp. 49–61*).—Experiments continued for 3 years indicate that a distance of 50 by 50 cm. gives the greatest yield of tubers and starch.

Cultural experiments with new varieties of potatoes, 1896, TANCRÉ (*Landw. Wochenbl. Schles. Holst., 47* (*1897*), *No. 6, pp. 101–106*).—Details of coöperative variety tests at 16 localities.

Potato tests, L. S. SPENCER (*Amer. Gard., 18* (*1897*), *No. 115, p. 154*).—A report is given of tests of 43 varieties of potatoes.

Variety tests of potatoes, MAAS (*Deut. landw. Presse, 24* (*1897*), *No. 15, pp. 125, 126*).—Tabulated data, including starch content, for 33 varieties tested on a private estate for from 1 to 7 years.

The culture of root crops, L. VANDENBERCH (*Belg. Hort. et Agr., 9* (*1897*), *No. 1, p. 9*).—Notes are given on the preparation and manuring of the soil.

Analysis of Australian saltbush (Atriplex semibaccatum), M. E. JAFFA (*California Sta. Rpt. 1895, pp. 165–171*).—Revised from Bulletin 105 of the station (E. S. R., 6, p. 717).

The nitrogenous constituents of beet juice, E. O. VON LIPPMANN (*Ztschr. Ver. Rübenz. Ind., 1896, Dec., pp. 957–965*).

Composition of sugar beets, sorghum, and sugar cane, M. E. JAFFA (*California Sta. Rpt. 1895, pp. 161–163*).—Tabulated analyses with reference to sugar content are given of 7 samples of sugar beets, 2 of sorghum, and 1 of sugar cane.

Culture of sugar beets on heavy soils, T. HOPPENSTEDT (*Deut. landw. Presse, 24* (*1897*), *Nos. 11, p. 85; 12, pp. 93, 94*).

Trial at Gembloux of a new sugar beet harvester, PYRO (*Bul. Agr.* [*Belge*], *12* (*1896*), *No. 6, pp. 251–261, pls. 4*).

The present condition of the sugar beet industry in the United States (*Mitt. deut. landw. Ges., 1897, Nos. 2, sup., pp. 9–12; 3, sup., pp. 17–21*).

Proximate analyses of sugar cane, sorghum, Egyptian corn, and millo maize, E. W. HILGARD and G. E. COLBY (*California Sta. Rpt. 1895, pp. 163, 164*).—Proximate composition was determined in 3 samples of sugar cane, 2 of sorghum, and 1 each of Egyptian corn and white millo maize. These samples were found to differ greatly in nitrogen content from the figures given in Lierke's tables.

Tobacco manures, S. PEACOCK (*Florida Agr., 24* (*1897*), *No. 9, p. 129*).

Tobacco growing in Florida (*Florida Farmer and Fruit Grower, 9* (*1897*), *No. 6, pp. 85, 86*).

On the decrease of the nitrogenous matter in the wheat of the Department de Nord, BALLAND (*Compt. Rend., 124* (*1897*), *No. 3, pp. 158, 159*).

Science in wheat growing, P. P. DEHÉRAIN (*Pop. Sci. Monthly, 50* (*1896*), *No. 1, pp. 101–105*).

General observations on wheat, BALLAND (*Compt. Rend., 123 (1896), No. 26, pp. 1303–1305*).

The influence upon grain and succeeding crop, of clover sown with the grain, STREBEL (*Würt. Wochenbl. Landw., 1897, No. 1, pp. 2, 3*).—Experimental tests proved that both the accompanying grain and the following crop were increased.

The maximum of plant production, A. MAYER (*Landw. Vers. Stat., 48 (1896), No. 1, pp. 61–76*).—The author has found from the yield of many field and forest crops that the maximum of production is between 7,000 and 8,000 kg. of organic dry matter per hectare for the north European region, and he believes the fixed amount of light and heat of the sun is the preponderant factor in determining this maximum.

Useful Australian plants, J. H. MAIDEN (*Agl. Gaz., N. S. Wales, 7 (1896), No. 11, pp. 737–741, pls. 2*).—Notes are given of a dwarf salt bush (*Atriplex halimoides*), bur medic, and a clover new to the colony. The species of clover is *Trifolium subterraneum*, a native of Europe.

Ensiling potatoes, L. GRANDEAU (*Jour. Agr. Prat., 61 (1897), I, No. 6, pp. 205, 206*).—A silo filled with potatoes was opened after 62 days and the contents found perfectly preserved.

Ensiling as a means of preserving some damaged crops, F. DESPREZ (*Jour. Agr. Prat., 61 (1897), I, No. 5, pp. 159–161*).—The author records favorable results from ensiling frosted potatoes, beets, cabbages, and ruta-bagas which showed signs of decay; and clover which could not be made into hay because of rain.

Report of the department of agriculture and horticulture, R. H. MCDOWELL (*Nevada Sta. Rpt. 1894, pp. 10–23*).—Notes are given upon hops, sugar beets, flax, grasses, potatoes, and peas grown at the station. The results are tabulated of experiments in applying land plaster to alfalfa; in seeding corn at different rates and dates and with varied numbers of irrigations, and in raising different varieties of wheat, barley, and oats.

Field experiments for 1895, J. CLAYTON (*Texas Sta. Prelim. Rpt., pp. 7*).—Tabulated data of crops from early and late planting of 39 varieties of cotton grown in 1894 and 1895, and yields of 63 varieties of corn grouped according to season of ripening.

Report on field crops, 1895–'96, A. DAMSEAUX (*Bul. Agr. [Belge], 12 (1896), No. 6, pp. 187–198*).—Variety tests of cereals, variety and fertilizer tests of sugar and fodder beets and other roots, a fertilizer test of fodder corn, and trials of miscellaneous crops are reported. Nitragin was used with contradictory results, peas on the soil where it was applied yielding less than on check plats, the nitrogen content being unaffected, while vetches yielded more and contained a larger percentage of nitrogen on the Nitragin plats.

Distribution of seeds, plants, cuttings, etc., E. J. WICKSON (*California Sta. Rpt. 1895, pp. 316–318*).—Tables are given showing the number of plants and cuttings and the weight of seeds distributed in accordance with announcements made in Bulletins 106 and 109 of the station (E. S. R., 6, p. 721; 7, p. 766). A financial statement for 4 years and tabulated data showing the extent of distribution are also given.

HORTICULTURE.

Irrigation for cabbage and cauliflower, E. S. GOFF (*Wisconsin Sta. Rpt. 1895, pp. 293–297, fig. 1*).—A plat of fertile clover sod was plowed about May 15, then dressed with stable manure at the rate of 68 tons per acre, and on August 16 received a liberal broadcast application of commercial fertilizers. On this plat, which was freely watered at time of planting, June 22, 60 4-rod rows of cabbage and 40 rows of cauliflower were set, the plants being 3 ft. apart each way. Twenty rows

each of cabbage and cauliflower were left as a check, and the remaining rows received about 17.2 in. of water at 4 applications as the plants seemed to need it. The season was very dry, as only 5.275 in. of rain fell, the normal precipitation being 17.86 in., so the test was well calculated to show the effect of irrigation. The principal data appear in the following table:

Yield of irrigated and unirrigated plats of cabbage and cauliflower.

	Number of plants.	Number of salable heads.	Plants headed.	Weight per hundred heads
Cabbage:			*Per cent.*	*Pounds.*
20 rows irrigated	446	395	88.5	880
20 other rows irrigated	421	383	90.9	899
20 rows not irrigated	442	347	78.5	590
Cauliflower:				
20 rows irrigated	435	347	79.7	492
20 rows not irrigated	361	235	65.1	306

Graphic diagrams are given showing effect of irrigation on head formation and weight of heads.

Irrigation appeared to increase the number of plants heading by 12 per cent in the cabbage and 14 per cent in the cauliflower, and to increase the average weight of heads 50 per cent in the cabbage and 66 per cent in the cauliflower.

The author was surprised that the unirrigated plants did so well, but ascribes it to the liberal application of manure and to the fact that the subsoil at setting time contained a fair amount of water which these deep-rooting plants were able to use. "The irrigation of cabbage and cauliflower did not prove profitable to the same extent as that of strawberries" (see p. 696).

A celery test (*Florist's Exchange, 9 (1897), No. 6, pp. 116, 117, figs. 6*).—An attempt was made on Long Island to test the claim previously made in this paper that it is possible for a whole field of celery to revert to the wild plant in a single season.

The experiment consisted in growing 65 varieties and strains, among them the Golden Self-Blanching, the one concerning which the claim was made. A careful examination was made of all plants and no variation was found that would warrant any such claim. Of the particular variety under special consideration, there was no variation observed in more than 100,000 plants examined. The author believes it would be impossible to cause any good strain to revert to a worthless one in a single season by bad culture or other means.

Analyses of California cherries, prunes, plums, and Logan berry, G. E. COLBY (*California Sta. Rpt. 1895, pp. 177–184*).—The author reports analyses of 6 samples of cherries, 5 of fresh prunes, 7 of dried prunes, 2 of plums, and 1 of Logan berry, some of the more important results of the analyses being shown in the following table (p. 691).

Analyses of California cherries, prunes, plums, and Logan berries—crop of 1894.

	Physical analysis.						In juice.		In fresh fruit.			
	Average weight.	Number per pound.	Flesh.	Pits.	Juice pressed.	Pulp pressed.	Total sugar.	Acid.	Sugar in flesh.	Sugar in whole fruit.	Nitrogen.	Albuminoids.
Cherries:	*Gms.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Royal Ann....	8.0	56.5	96.0	4.0	82.00	18.00	11.41	0.496	9.36	8.98	0.183	1.140
Black Tartarian..........	7.5	59.8	95.4	4.6	87.50	12.50	12.85	.306	11.21	10.64	.244	1.520
Royal Ann....	8.5	54.1	96.7	3.3	81.40	18.60	13.00	.384	10.58	10.05	.220	1.370
Black Tartarian..........	6.2	72.9	94.7	5.3	81.00	19.00	15.03	.296	12.16	11.51	.242	1.412
Do........	7.0	64.2	94.0	6.0	89.70	11.30	15.12	.268	13.56	12.75	.206	1.287
Napoleon Bigarreau ..	8.5	54.1	95.4	4.6	79.10	20.90	15.77	.368	12.45	11.82	.278	1.727
Prunes:												
French	20.5	22.0	95.1	4.9	82.00	18.00	22.00	.250	17.70	16.80	......	......
Do........	27.5	16.4	93.4	6.6	90.50	9.50	23.10	.240	20.80	19.50	......	......
Tennant.......	......	......	......	......	......	......	......	......	......	9.40	......	......
French	13.5	33.4	94.0	6.0	76.00	24.00	11.16	......	8.90	6.90	......	......
Italian.........	27.4	16.5	94.9	5.1	71.60	28.40	13.00	......	9.30	6.90	......	......
Dried prunes:												
French	11.6	39.0	85.7	14.3	......	......	......	......	[1] 35.20	......	......	......
Do........	4.0	113.0	......	......	......	......	......	.880	[1] 51.00	......	......	......
Do........	6.2	73.0	......	......	......	......	......	.800	[1] 50.00	......	......	......
Do........	......	......	......	......	......	......	......	.800	[1] 53.00	......	......	......
Do........	......	44.0	......	......	......	......	......	.880	[1] 50.60	......	......	......
Do........	......	80.0	......	......	......	......	......	......	[1] 50.80	......	......	......
Do........	......	90.0	......	......	......	......	......	......	[1] 49.00	......	......	......
Plums:												
Primordian ...	11.0	41.0	94.0	6.0	87.00	13.00	10.41	......	9.05	8.50	......	......
Simon	67.0	6.7	97.1	2.9	80.00	20.00	6.25	.820	5.00	4.80	......	......
Logan berry......	5.0	90.4	......	......	88.07	11.93	8.90	.960	......	8.00	.175	1.094

[1] Sugar in whole dried fruit.

Complete ash analyses are given of cherries, and from these the author has calculated the fertilizing ingredients removed by 1,000 lbs. of fresh cherries, as follows:

Fertilizing ingredients removed by 1,000 pounds of fresh cherries.

	Pounds.
Potash	2.77
Phosphoric acid	.72
Other ash ingredients	1.33
Nitrogen	2.29
Total ash	4.82

The olive in the Chino Valley, J. W. MILLS (*California Sta. Rpt. 1895, pp. 438, 439*).—A brief report is given of pollination experiments conducted with several varieties of olives, from which the general conclusion is drawn that the higher bred or larger olives produce pollen having greater vitality than that of the smaller ones. This result is based upon one year's experience, and the same line of work is to be continued.

Analyses of California oranges and lemons, G. E. COLBY (*California Sta. Rpt. 1895, pp. 172–177*).—In continuation of the analyses given in the previous report of the station (E. S. R., 6, p. 815), the author gives analyses of 14 additional varieties of oranges, 1 of lemon,

1 of lime, and 2 of pomelos. A report is also given of the effect of various fertilizers on Australian and Washington navel oranges, and the results of analyses are shown in the following table:

Effect of fertilizers upon the fruit of navel oranges.

Fertilizer.	Physical analysis.				Analysis of juice.			Nitrogen in fresh fruit.
	Average weight.	Rind.	Pulp, pressed.	Average juice.	Total solids (by spindle).	Total sugars (inversion).	Citric acid.	
	Grams.	*Per ct.*	*Per ct.*	*Cc.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Barnyard manure	190	41.0	25.7	55	13.80	10.37	1.75	0.184
Not fertilized	153	37.8	29.3	50	15.15	12.22	1.96	.175
Nitrate of soda	160	39.4	26.0	55	13.65	10.18	1.82	.170
Superphosphate (from boneblack)	193	43.2	22.2	65	13.80	10.31	1.82	.171
Muriate of potash	205	38.2	30.0	58	14.40	12.20	1.40	.158
Nitrogen and phosphoric acid	160	39.2	25.0	48	13.90	11.24	1.51	.184
Nitrogen and potash	208	34.7	26.2	70	13.30	10.38	1.27	.182
Potash and phosphoric acid	208	34.8	27.4	68	13.30	10.10	1.20	.185
Nitrogen, phosphoric acid, and potash	173	40.9	21.2	55	15.05	11.79	1.96	.183

The author states that rigorous interpretation of the results of his experiments will reveal many contradictions, and before much weight can be given such analyses the experiments must be repeated on an extended scale for several consecutive years.

In regard to nitrogen, it was found that muriate of potash and nitrate of soda lowered the nitrogen content of the fruit as compared with unfertilized fruit. That muriate of potash apparently increases sugar and decreases nitrogen seems to be about the only definite conclusion that can be drawn from the experiments thus far conducted. The lack of any standard for comparison is a serious drawback to this kind of work.

Fertilizer experiments with potash salts for oranges are briefly reported, and it is shown that while the oranges of the different lots weighed practically the same, those not treated with potash had a thicker rind and a larger average of juice, and those treated with potash had a larger total amount of pulp. The ash of the orange was about the same in the 2 lots, the percentage of potash being a little higher for the trees receiving a potash fertilizer, and the phosphoric acid content was about 5 per cent higher in the fruit from trees receiving no potash. The potash seems to have had a slight effect in increasing the sweetness of the juice, there being 1.3 per cent more total sugar and 0.56 per cent more cane sugar for the trees receiving potash. The citric acid was not influenced. The author states that had sulphate of potash been used instead of muriate probably the effect on sugar content would have been greater.

Blossoms of the plum and apricot, E. S. Goff (*Wisconsin Sta. Rpt. 1895, pp. 300–303*).—The study of plum blossoms with reference to their fertility, commenced in 1894 and noticed in the Annual Report of the station for that year (E. S. R., 8, p. 309), was continued. It was

found that in an unknown variety of Russian apricot which blooms earlier than the plum, the blossoms were about equally numerous on the wood of 1892, 1893, and 1894, but that the percentages of flowers bearing perfect pistils were 83.1, 66.1, and 5.3 respectively. Examination of several varieties of plums, however, furnished "no positive evidence that the younger wood on the whole produced less fertile flowers than the older, though this may be true in certain varieties."

The data are tabulated for the varieties examined.

Horticultural experiments at Southern Pines, 1895 (*North Carolina Sta. Bul. 129, pp. 159–201, figs. 24*).—A report is given on a series of experiments undertaken at Southern Pines, North Carolina, under the joint direction of the State Horticultural Society, the Experiment Station, and the German Kali Works, the object of the work being to determine the proportion of the different fertilizing ingredients necessary for the best growth and development of orchard and garden fruits and other horticultural and agricultural products, and the best treatment of the soil to produce this result. No commercial brand of fertilizer is used, but fertilizing ingredients are employed in various combinations. The location of the experiments, the geology of the region, and climatic conditions are given at considerable length.

Chemical and physical analyses of the soil have been made. The character of the soil is sandy, with sandy subsoil of uncertain depth. Originally the land was covered with long-leaf pine, but at the beginning of the experiment it was partially covered with a growth of smaller pines, oaks, and dogwood, the merchantable timber having long since been removed. It had never been under cultivation.

The methods pursued in clearing and preparing the land for planting, laying out the plats, setting plants, and subsequent cultivation are described in detail.

The general plan of the experimental tests adopted consisted of a series of tenth-acre plats for each of the fruits excepting the small fruits, the plats for which were fortieth-acre. The basis of the fertilizer applications was potash equivalent to 50 lbs. per acre, phosphoric acid equivalent to 50 lbs. of available phosphoric acid per acre, nitrogen equivalent to 20 lbs. per acre, 2,000 lbs. of slacked lime per acre, and green manuring with cowpeas. The analyses of the various fertilizing materials and amounts applied per tree are given.

The varieties of fruits selected for the experiments were Lady Thompson strawberry; Cuthbert raspberry; Early Wilson blackberry; Niagara and Delaware grapes; Elberta peaches; Abundance, Burbank, Maru, Ogon, Pool Pride, and Wayland plums; Kieffer pears; McCuller Winter apples; and Japanese Mammoth chestnuts.

The weather conditions during 1895 were somewhat noteworthy on account of the low temperature during January, February, and April, and the high temperature from August to December. The precipitation was greatly above the normal in March and April and below in September and October.

In general, newly planted orchards are not greatly troubled by insect and fungus pests, but in this series of experiments considerable trouble was occasioned by attacks of a species of native ants (*Solenopsis geminatus*), which were very abundant in these pine lands. Various methods were undertaken to prevent the attacks of this pest on the different trees, but none of them could be considered a complete sucess. It appears that early and persistent spraying with Paris green, not to exceed 3 oz. to 50 gal. of Bordeaux mixture, combined with continuous stirring of the ground, will kill or drive the ants away. The addition of 1 gal. of molasses to the ordinary Bordeaux mixture was found an improvement, since it made it adhere much better to the foliage. The shot-hole fungus (*Septoria persicæ*) and the grape mildew were the only fungus pests which were noticed to any extent, and these were kept in check fairly well with Bordeaux mixture, the shot-hole disease proving rather less amenable than the mildew to preventive treatment.

The most serious difficulties encountered during the first year's experiments were those arising from the use of fresh land, late planting, bad weather conditions, and inability to secure choice nursery stock. The blackberries, peaches, plums, and grapes were injuriously affected by the abnormal conditions already named. The blackberries were injured to such an extent that no results could be considered accurate, and a new planting was necessary. The peaches were badly injured by the abnormal weather conditions and the ant depredations, many of the trees failing to grow. In regard to the plums, the conditions during the first year were such that conclusions as to growth would be untrustworthy, and are omitted. In the experiments with grapes there was a much more even growth, and the appearance of the various plats was more satisfactory.

It is evident that the following conclusions may be drawn from the grape experiments:

"(1) A very large increase of growth is caused by the application of fertilizers properly compounded, although it can not be definitely stated with only the result of one season's growth what is the best proportion; (2) lime in connection with the complete application of the 3 ingredients very greatly increased the vine growth, and that this effect is probably due in a great degree to the beneficial action of the lime upon the fresh soil by aiding in the decomposition of organic matter, and thus neutralizing the effect of organic acids produced; (3) the sulphate as a source of potash appears to be of greater value than the muriate; whether this result is due to the fact that the sulphate can be more easily taken up by the vine in the process of growth or that the sulphate has acted chemically upon the soil to render more available the compounds already present, is not altogether apparent, but it is likely that both causes have been effective; (4) the broadcast sowing of cowpeas for green manuring on fruit crops near the vines and trees is not to be commended, but a sufficient open space should be left between them so as to prevent any interference with the growth of the fruit crops."

Experiments with mulches at Paso Robles Station, C. H. SHINN (*California Sta. Rpt. 1895, pp. 401–403*).—On account of the exceptionally dry conditions that prevailed during the winter of 1893–'94 in the

vicinity of this station neglected orchards and vineyards suffered severely the following season. At the station the orchard and vineyard were carried through the season in good condition by thorough and constant cultivation.

An experiment was conducted with mulches in the vineyard and peach orchard, 5 plats of about one-tenth acre each being treated. The first plat in the vineyard was mulched with fresh stable manure to a depth of 3 in., the second with a mulch of cultivated earth 5 in. deep, and the third with a mulch of rotten straw 6 in. deep. The plats in the peach orchard were mulched with 3 in. of fresh stable manure and by cultivation to a depth of 5 in. The results obtained in these experiments are tabulated. The conclusions of the author, drawn from this table, show that the mulch of fresh stable manure which was applied early in the season served better for obtaining moisture than the mulch of cultivated earth. Late showers, although very light, may have influenced this to some extent.

Influence of north and south slopes on the temperature of the trunks of fruit trees, F. H. King (*Wisconsin Sta. Rpt. 1895, pp. 268–272, fig. 1, dgm. 1*).—In order to observe the changes in temperature in the trunks of trees three observation stations were selected, one upon the summit of a hill 108 ft. above and 1,000 ft. distant from Lake Mendota, another on the south slope 32 ft. below the summit, and the third on the north side 34 ft. below. At each of these stations there was set in the ground a section of a second-growth black oak tree, 8 in. in diameter and projecting 36 in. above the surface. In the top of each post vertical five-eighths-inch holes 16 in. deep were bored 1 in. inside the bark on the north and south sides, and chemical thermometers were lowered to the bottom of the holes. These could be drawn up by strings for reading. The top of each tree trunk was covered with a narrow board, to which was secured a tight galvanized-iron shelter containing a self-recording air thermometer.

The temperatures of the tree trunks were read daily at 7 a. m. and 1 p. m. during December, 1894, January, February, and March, 1895.

The following table shows the monthly mean temperatures:

Mean temperatures in the north and south sides of tree trunks.

Month.	South slope.				Summit.				North slope.			
	South.		North.		South.		North.		South.		North.	
	7 a. m.	1 p. m.	7 a. m.	1 p. m.	7 a. m.	1 p. m.	7 a. m.	1 p. m.	7 a. m.	1 p. m.	7 a. m.	1 p. m.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
December	27.99	42.98	28.60	32.76	29.25	39.79	28.38	32.57	28.78	36.72	28.42	32.99
January	7.57	31.28	9.03	18.59	8.35	26.60	8.37	16.12	7.93	23.11	8.17	15.39
February	8.73	37.15	8.67	20.55	8.92	35.58	9.08	17.47	9.63	28.27	8.73	16.57
March	27.68	47.91	28.13	35.28	27.68	45.12	28.44	29.82	27.55	41.04	27.79	33.39
Mean	17.99	39.83	18.61	26.80	18.54	36.28	18.57	24.00	18.47	32.29	18.28	24.58

From this table it appears that the mean diurnal change in the south side of the tree trunks was 21.84° F. on the south slope, and 13.82° on

the north slope, a change 8.02° greater for the south than for the north slope. Similarly, the change in the north side of the tree trunks was 1.89° (8.19—6.30) greater for the south slope.

The maximum change occurring in any one day in the south side of the trees was 52.1° for the tree on the south slope, and 36.6° for the one on the north slope, a difference in the amount of change of 16.5°.

"It is evident from these data that in orchards which are planted on southern exposures the trunks of the trees must be subjected to much wider changes of temperature during each 24 hours than where they are planted on northward slopes.

"It will be noticed that the table shows, not simply that the temperature of the south side of the tree trunk on the south side of the hill becomes much warmer at midday, but also that it is the coldest in the coldest part of the day, and it will be seen that this is true, not simply in the average for the four months, but that it is also true for the mean of each individual month. On the north slope of the hill there is a slight tendency for the north side of the tree trunk to be coldest in the morning, while at the summit of the hill the two sides have still more nearly the same temperature in the morning when it is coldest. These small differences are due to the fact that the radiation of heat from the ground on the uphill side against the tree trunk is stronger than it is on the downhill side."

The records of air thermometers for the three months in 1895 were platted in the form of curves, and show "that for each of the three months the diurnal range of temperature is least on the summit, it being colder there in the middle of the day and warmer in the night, the difference increasing from January to March, where it is very marked . . . and that the south side of the hill is colder than the north side in the latter part of the night, just as was indicated by the thermometers placed in the tree trunks."

Irrigation of strawberries, E. S. Goff (*Wisconsin Sta. Rpt. 1895, pp. 289–292, figs. 2*).—A continuation of work reported in the Annual Report of the station for 1894 (E. S. R., 8, p. 310). Three plats, each comprising 12 50-foot rows of Warfield and 4 rows of Wilson berries, were used in the test. The first plat had been well irrigated the previous season, received 3 applications of water between May 25 and June 22, and yielded 561.3 boxes; the second plat had been well irrigated in 1894 but was left without watering in 1895, and yielded 111.6 boxes; while the third plat, which had never been irrigated, yielded 66.2 boxes. The results are shown graphically and by illustrations of the yields from single pickings of irrigated and unirrigated rows.

"Late summer irrigations, however beneficial they may be in producing plenty of vigorous plants, will be rendered nearly futile unless supplemented by timely irrigations when the fruit is forming and maturing."

Experiments in strawberry culture, E. S. Goff (*Wisconsin Sta. Rpt. 1895, pp. 279–288*).—A table is given showing the yield for 3 consecutive seasons of a plat of 47 varieties. The plants were grown in matted rows, received good culture, and were well protected in winter. After gathering the first and second crops the matted rows were narrowed to 12 in., the remaining plants well thinned, and a top-dressing

of manure applied. Irrigation was commenced late in the first season and continued until after the third crop was harvested. At the close of the second season the tops of the plants were mowed off and burned between the rows with what was left of the mulching material.

The total yields for the successive seasons were 1,038.6, 786.9, and 1,090.1 boxes. Six varieties yielded best the first year, 3 varieties the second year, 12 varieties the third year, several nearly the same for all seasons, but the majority of the kinds yielded less the second season than either the first or third.

Descriptions are given of 10 of the most productive varieties. The author recommends Beder Wood, Warfield, and Parker Earle for market or home use.

Frost threatening the destruction of the crop just when the plants were coming into bloom, an attempt was made to prevent the damage by covering the rows with marsh hay. This had been used as a winter protection and had been stacked near at hand for mulching purposes. The plants on the three-fourth acre plat were covered 3 times, at an expense of $5.79, or about $8 per acre. All exposed blossoms were killed, but those covered escaped injury and produced a crop realizing more than $300 per acre.

A series of experiments was begun in 1892 to test the relative productiveness of early and late formed matted rows. On one plat all runners were picked off until September 1 and then allowed to form plants; and on the other plants were allowed to form only before this date. The yield in 1893 from the plat of early-formed rows was 202.5 qt., from the late-formed rows 100 qt. As no account was taken in this test of the relative number of plants in the rows, a second trial was conducted in 1894 in which the numbers of plants in the rows were made uniform. The early-formed rows gave 202.4 qt., the late-formed rows 161.1 qt. From these experiments the author concludes that "the earlier formed matted rows were more productive; . . . the earlier formed plants were more productive; . . . we can not depend upon plants to form well-matted rows late in the season."

Growth of trees, shrubs, and other plants on alkali soils, C. H. SHINN (*California Sta. Rpt. 1895, pp. 416–421*).—Notes are given on tests which have been conducted for several years at the San Joaquin Valley Station on the growth of trees on alkali soils. As some of these have not been sufficiently tested, the experiments are to be continued.

Kolreuteria paniculata, a handsome, small tree, was found to grow in soils that were very alkaline. In fact, it and *Atriplex semibaccatum* were the only culture plants growing in such places. *Tamarix gallica* showed remarkable resistant powers, growing quite readily in what are known as black alkali soils. The European sycamore (*Platanus orientalis*) has grown well at the Tulare Station in soils which were too strong in alkali for the growth of *Eucalyptus globulus*. Of a number of

species of poplars tested, the common Lombardy poplar and *Populus fremontii*, *P. monilifera*, and *P. canadensis* are considered the best for alkali soils. The Japanese camphor tree (*Camphora officinarum*) and the strawberry tree (*Arbutus unedo*) have grown fairly well on moderately strong alkali soils. Of the oaks tested, the cork oak seems to have made very satisfactory growth, although the amount of alkali was not high. The native white oak (*Quercus lobata*) often grows in strong alkali basins, and it is thought that *Q. cerris* will prove valuable under the same conditions. Of the walnuts tested, the English walnut (*Juglans regia*) is found to withstand alkali very poorly. One of the native species, *J. californica*, is somewhat more resistant to alkali, while *J. nigra* makes very slow growth. The pecan (*Carya olivæformis*) withstands alkali and heat better than any of the walnuts with the exception of *J. californica*. Nearly all of the leading varieties of mulberries have been tested at the station and found to do fairly well on alkali soils. The American varieties thrive on medium grades of alkali, but are less resistant than the Oriental forms. Most of the Pacific Coast and large-leaved forms of Japanese maple will not grow at the station, the European and silver maples and the Negundos doing fairly well. Of the elms, a slippery elm (*Ulmus fulva*) has made the best growth of any of the trees tested. The leaves of *Ulmus americana* burn badly and the tree does poorly. The various locusts which have been tested make vigorous growth on strong alkali soils. The carob tree (*Ceratonia siliqua*) is fairly well adapted to resist alkali, and on account of its thick, firm leaves has few equals in enduring the hot sun. It is well adapted to mesa lands at Santa Monica without irrigation, as well as to many of the dry California hillsides. Quite a number of species of Eucalyptus have been tested, the most satisfactory of which are *E. amygdalina*, *E. rostrata*, *E. viminalis*, and probably *E. resinifera*. On medium alkali soils *Grevillea robusta* makes a satisfactory growth, but on heavier soils the leaves suffer. Among the palms tested the wild date (*Phœnix canariensis*) and fan palm (*Washingtonia filifera*) have proved best on medium-grade alkali soils. Among the conifers there are few found that will adapt themselves to the conditions of the alkali. *Juniperus phœnicia* succeeds fairly well, and *Pinus canariensis* quite well. Of the California timber trees all except *Pseudotsuga douglasii* are found very sensitive to alkali.

Of the shrubs tested, species of Kunzia, Fabiana, oleanders, crape myrtle, lemon verbena (*Aloysia*), and smoke tree (*Rhus cotinus*) have grown well.

Numerous vines were tested, and it was found that the fine starch plant from Japan (*Pueraria thunbergiana*), wistarias, and jasmines, if protected from the full sun, will withstand considerable alkali. The trumpet creeper (*Tecoma radicans*) is also very resistant to alkali.

Among the garden plants which grow successfully on strong alkali soils are portulaccas, calandrinas, ornamental-leaved beets, ice plants,

the hardier mesembryanthemums, the various yuccas, verbenas, cannas, violets (if well shaded), hollyhocks, and tuberoses.

Of the fruit trees tested, the most resistant of all is the pomegranate. The common quince and pear are also hardy. The Japanese species of quince sheds its bark and is not a success. Next in rank after the pear in resistance is the plum. On strong alkali soils no fruit trees excepting pomegranates and mulberries can be safely planted. The quince and pear should be limited to low or medium grades of alkali. Trees, while sometimes growing fairly well in alkali soils, may produce worthless fruits, but both mulberry and pomegranate fruits, when grown in strong soil, are of good quality.

Gaseous fermentation in the canning industry, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1895, pp. 227–231*).—The author's attention was called to a more or less serious trouble caused by the after fermentation of canned goods. The spoiled cans, technically known as "swells," are filled with gas and absolutely worthless.

A biological examination of the canned material, which in this case was peas, showed that the spoiled goods were invariably in an advanced stage of bacterial fermentation. Cultures made from the material revealed the presence of 2 different species of bacteria, one of which proved to be an organism capable of fermenting sugar solutions with a copious evolution of gas. Experiments were made with this organism, and it was demonstrated that it was largely the cause of the fermentation. Having determined the cause of the trouble, an attempt was made to discover means for its prevention.

The various steps in canning peas are shelling, grading, blanching by means of immersing in boiled water for 1 or 2 minutes, placing in cans, filling cans with a solution of salt, to which sugar is added where the amount is deficient in the peas, hermetically sealing the cans, and cooking in a tightly closed steam cooker. In some varieties of peas long-continued boiling results in splitting the skin, and the mealy part renders the liquid contents turbid. In order to prevent this, experiments were conducted in which the effect of sterilization by means of greater steam pressure and higher temperature was tested. This procedure was confidently believed to be fatal to bacterial life, but its effect on the quality of the canned product was unknown.

An experimental lot of a few cans was cooked under a steam pressure of 18 lbs. at a temperature of over 250° F. The cans were opened after this process and the liquid was found to be clear and the peas intact. This experiment having demonstrated that the quality of the peas was not affected, so far as could be determined at that time, it was repeated on a much larger scale in order to test the keeping quality of the product. The details of this second experiment are given in the following table.

Details of canning peas.

	Peas rich in sugar.		Peas deficient in sugar.	
	Usual process.	Experimental process.	Usual process.	Experimental process.
Steam pressure in cooking ......pounds..	10	15	11	15
Temperature ......degrees F..	232	242	234	242
Time ......minutes..	26	28	17	30
Number cans "processed" ......cans..	6,175	11,859	4,607	2,520
Number cans "swells" ......do...	306	8	135	14
Per cent of swells ......per cent..	5	(1)	2 3	2 0.5

1 Practically none. 2 About.

The results of this experiment were highly gratifying, as there was a material diminution in the amount of spoiled product. It is confidently expected that the frequently disastrous losses could be almost entirely prevented by the application of increased pressure without necessarily lengthening the time of exposure.

Alcoholic vapor as a preventive of mold and preservative of fruit, E. S. GOFF (*Wisconsin Sta. Rpt. 1895, pp. 304–306*).—Plums were wrapped in paper and placed in boxes under bell glasses.

Small bottles of water were placed under each glass and a bottle of alcohol under one of them. The glasses were kept from August 31 to September 16 in a refrigerator containing ice. The plums subjected to the alcoholic vapors were then in slightly better condition than the others, being entirely free from mold and somewhat less decayed. In both lots the plums seemed to absorb moisture and the skins of many had burst. The state of maturity and flavor of the fruit was the same beneath the two glasses.

Other plums and an apple were kept under a bell jar with open bottles of alcohol and water from August 28 to November 19. No decay was apparent, but the natural flavor of both plums and apple was destroyed.

Fumes of alcohol in a Geneva seed tester while preventing mold on the cloth also prevented germination.

Castor bean culture, (*Coleman's Rural World, 1897, Feb. 4, p. 1*).

Cucumber forcing, A. WILLARD (*Meehan's Monthly, 7 (1897), No. 3, p. 57, fig. 1*).—Brief notes are given on forcing cucumbers, with mention of varieties best adapted to this use.

Onion cultivation, P. E. BUCKE (*Canadian Hort., 20 (1897), No. 2, pp. 65–67*).

Experiments on the rhubarb plant, PAGNOUL (*Ann. Agron., 22 (1896), No. 12, pp. 575–578*).

Report of tests of field and garden vegetables, E. J. WICKSON (*California Sta. Rpt. 1895, pp. 333–337*).—Reports are given from voluntary experimenters upon the following plants distributed by the station: New Zealand spinach, Zig-Zag sweet corn, perennial beans, new short white carrot, Logan berry, and the Jamaica tree tomato (*Solanum betaceum*).

Some neglected vegetables, G. ALLUARD (*Rev. Hort., 69 (1897), No. 3, pp. 55–58*).—Notes are given of vegetables which are but little known, and many of which are seldom grown.

Greenhouses and grounds of the Central Station, E. J. WICKSON (*California Sta. Rpt. 1895, pp. 307–311*).—Descriptive notes are given of the greenhouses and grounds of the station, with the outline of work provided for.

The almond and fig in southern Tunis, ESPINASSE-LANGEAC (*Bul. Chambre Commerce et Agr. Sfax, 1896, pp. 81–86*).

The carob tree, L. GRANDEAU (*Jour. Agr. Prat., 60 (1896), II, No. 53, pp. 969–971*).

Notes on dates and date culture in southern Tunis, ESPINASSE-LANGEAC (*Bul. Chambre Commerce et Agr. Sfax, 1896, pp. 116–119*).

Results of analyses of olives, G. E. COLBY (*California Sta. Rpt. 1895, pp. 218–227*).—Tabulated reports are given of partial analyses of California olives from the crops of 1890–'95. Over 200 samples have been analyzed.

Olives, A. P. HAYNE (*California Sta. Rpt. 1895, pp. 195–217*).—Complete directions are given for pickling olives, and descriptions of varieties, oil machinery, classification of oils, etc.

Report on olive culture, VAILLON (*Bul. Chambre Commerce et Agr. Sfax, 1896, pp. 77–80*).

Different varieties of Reine-Claude plums, E. MICHIELS (*Belg. Hort. et Agr., 9 (1897), No. 4, pp. 53, 54*).—Thirteen distinct forms are described.

Small fruit culture for market (*Canadian Hort., 20 (1897), No. 2, pp. 63–65*).—Notes are given on the selection of location, preparation of soil, etc., for strawberry, blackberry, raspberry, currant, and gooseberry culture.

Preparation of fruit specimens for exhibitions, E. W. HILGARD (*California Sta. Rpt. 1895, pp. 272–276*).—Notes are given for the conservation of fruit samples for permanent exhibitions, including directions for the proper selection of specimens. Different preserving agents are described, and the density of the fluid required is commented upon.

Experiments with land plaster for grape vines, E. MARRE (*Prog. Agr. et Vit., 27 (1897), No. 6, pp. 151–155*).

Practical grafting of grape vines, V. VERMOREL (*Le greffage practique de la vigne. Paris: Michelet, 1897*).

Grape growing under glass, W. SCOTT (*Amer. Gard., 18 (1897), No. 115, p. 156*).

American vines in Bouziers, J. JALLABERT (*Prog. Agr. et Vit., 27 (1897), No. 5, pp. 121–128*).—Notes are given on *Vitis riparia* and *V. rupestris* stocks.

The carnation: From taking of the cutting to planting in the field, W. R. SHELMIRE (*New England Florist, 2 (1897), No. 52, pp. 430, 431*).—A paper presented before the American Carnation Society.

The carnation in the field and in the house, H. WEBER (*New England Florist, 2 (1897), No. 52, pp. 431, 432*).—A paper presented before the American Carnation Society.

The development of roots from cuttings, L. C. CORBETT (*Meehan's Monthly, 7 (1897), No. 2, pp. 32–34, figs. 3*).—It is shown that the roots of cuttings do not have their origin in the callus, but grow from the tissue of the portion of the plant used as a cutting.

Winter pruning, J. PHILLIPE (*Belg. Hort. et Agr., 9 (1897), No. 4, p. 52*).

Propagating plants by cuttings, T. D. HATFIELD (*Garden and Forest, 10 (1897), No. 409, pp. 65, 66*).—Notes are given for propagating by cuttings, with mention of those plants requiring especial treatment.

Report of experiments at the San Joaquin Valley Culture Station, C. H. SHINN (*California Sta. Rpt. 1895, pp. 404–415*).—A report is given of the cultural work at the station, with climatic notes and tabulated data, and detailed statistical tables showing the dates of blooming, leafing, first ripe fruit, weight and size of fruit, etc., of varieties of almonds, apples, apricots, nectarines, peaches, pears, plums, and prunes, together with brief notes on the culture of the fig in Tulare County.

Miscellaneous analyses, G. E. COLBY (*California Sta. Rpt. 1895, pp. 183–185*).—The author gives a partial analysis of seedless persimmon, the starch content of the California buckeye fruit, and of a sample of commercial albumin for wine fining and

an examination of licorice roots. In connection with the report on the licorice roots, the author states that the plant grows readily in California, and the only question in its culture is a commercial one—whether under existing conditions California can compete with the cheaper labor of other countries.

Report of the Foothill Culture Station, C. H. SHINN (*California Sta. Rpt. 1895, pp. 338–357, pls. 2*).—A report is given on the botany of the district and topography and general plan of the station plantation. An extended report is given of various orchard fruits and 13 varieties of almonds, 55 of figs, 70 of peaches, and 50 of prunes and plums.

Miscellaneous horticultural work, E. S. GOFF (*Wisconsin Sta. Rpt. 1895, pp. 298–306, fig. 1*).—Notes are given upon a test of a patent weeder, on a few varieties of plums fruiting during the season, and on the plum curculio.

The Maryland tree and nursery stock law and other information of special interest to nurserymen and fruit growers, W. G. JOHNSON (*Maryland Sta. Bul. 42, pp. 145–162, figs. 6*).—The text of the tree and nursery stock law is quoted and the relation of the author toward the enforcement of this law is explained at some length.

The present condition of the nurseries of the State is briefly reviewed, in which it is shown that on the whole they are in very good condition.

The San José scale has been located in 3 nurseries and, as far as final inspection by the author shows, has been completely destroyed. Illustrated notes are given on the San José scale, with suggestions for its destruction.

Peach yellows and peach rust are also illustrated and described.

FORESTRY.

Timber physics in California, C. H. SHINN (*California Sta. Rpt. 1895, pp. 291–303*).—Attention is called to the investigations of the Pacific Coast timbers conducted by the department of civil engineering of the university, and directions are given for the collection of test pieces of these timbers. The results of investigations of Humboldt redwood (*Sequoia sempervirens*) conducted by F. Soule, which have already been issued as a special bulletin, are briefly given.

An outline is given of the future work, and notes on life history of the woods, seasoning of timbers, and confusion in common names, with compiled tables on timber tests of *Pinus sylvestris* in Europe, the comparative value of various timber trees, specific gravity and weight of woods, comparative transverse strength of woods, and relative rank of some American woods.

Acclimation of larch in Belgium (*Bul. Soc. cent. Forst. Belg., 4 (1897), No. 2, pp. 123–126*).

The Visalia oaks, C. H. SHINN (*Garden and Forest, 10 (1897), No. 468, pp. 52, 53, pl. 1*).—An account is given of an extensive grove of *Quercus lobata* growing in very strong alkali soil.

Contribution to the natural history of the Weymouth pine, WAPPES (*Bul. Soc. cent. Forest. Belg., 4 (1897), No. 2, pp. 105–123*).—Notes are given on the life history of *Pinus strobus*.

Pinus laricio pallasiana, A. D. WEBSTER (*Gard. Chron., ser. 3, 21 (1897), No. 526, pp. 57, 58*).—Attention is called to this tree, which is said to be valuable for forest planting, especially in peaty soils.

Concerning some forest products (*Bul. Soc. cent. Forst. Belg., 4 (1897), No. 2, pp. 74–94*).

Forest injury due to iron works, R. HARTIG (*Forstl. naturw. Ztschr., 6 (1897), No. 1, pp. 40–44, fig. 1*).—An account is given of a serious injury to fir trees which the author thinks is traceable to fumes from adjoining iron works.

Forest fires and how to prevent them, H. N. JARCHOW (*Forester, 2 (1897), No. 2, pp. 21–23*).—Discusses some of the causes of forest fires and gives methods for their prevention as well as for combating them.

Report of the forestry stations, C. H. SHINN (*California Sta. Rpt. 1895, pp. 440–445, pls. 4*).—A report is given of the present condition and outline of work of the forestry stations at Santa Monica and Chico.

The forests of Pennsylvania, C. A. KEFFER (*Garden and Forest, 10 (1897), No. 471, p. 88*).

SEEDS—WEEDS.

On the structure of the seed coats of certain species of Brassica and Sinapis, O. BURCHARD (*Jour. Landw., 44 (1896), No. 4, pp. 337–341, pl. 1*).—On account of the substitution of seed of different species of these plants in oil manufacture and in oil cake the author has continued his study of their seed coats. He finds in the sclerenchyma characters by which they can be readily distinguished. In the present paper he gives the characteristics of the seed coats of *Sinapis dissecta*, *S. trilocularis*, and 2 varieties of *S. juncea*, comparing them with *S. alba*. There is also given an analytical key, based upon anatomical and microscopical characters, to 16 of the species of Sinapis and Brassica most commonly found in the trade.

Noxious weeds and how to destroy them, III, (*Dept. Agr. and Immigr., Manitoba, 1897, pp. 39, figs. 16*).—The author points out the importance of eradication of weeds and briefly describes their origin, distribution, preventives, and methods for eradication. The following weeds are described, some of which are new to the country or have but recently become troublesome: Penny cress, wild mustard, tumbling mustard, hare's ear mustard, false flax, summer rape, ball mustard (*Neslia paniculata*), pepper grass, spider flower (*Cleome integrifolia*), gum weed (*Grindelia squarrosa*), showy lettuce (*Mulgedium pulchellum*), prickly lettuce, great ragweed, Roman wormwood or bitter weed, marsh elder (*Iva xanthiifolia*), Canada thistle, perennial sow thistle, common sow thistle, prairie thistle (*Cnicus undulatus*), oxeye daisy, Canada fleabane, false tansy (*Artemisia biennis*), cow herb, sticky cockle (*Silene noctiflora*), chickweed, carraway, fumitory, wild rose (*Rosa blanda*), silver weed (*Potentilla anserina*), black bindweed, Russian thistle, Russian pigweed (*Axyris amaranthoides*), couch grass, and wild oats.

The relation of weed seeds to the milling industry is shown, and the subject is considered sufficiently important for future investigation. The presence of seed of the giant ragweed in wheat or oats is said to greatly depreciate the value of the grain.

The weed law of Manitoba is quoted, and a table of 75 weeds, in which is given their common and scientific names, where injurious, annual or not, time of flowering, seeding, methods of eradication, etc., concludes the bulletin.

Seed sampling and testing, A. CLEMENT (*Belg. Hort. et Agr., 9* (*1897*), *No. 4, p. 57*).

The water hyacinth in Florida, H. J. WEBBER (*Florida Agr., 24* (*1897*), *No. 8, p. 118*).—Notes are given of the introduction and spread of this aquatic plant, with some suggestions for possible relief.

The Russian thistle in California, C. H. SHINN (*California Sta. Rpt. 1895, pp. 277–291, pls. 2*).—A reprint of Bulletin 107 of the station (E. S. R., 7, p. 136).

Combating couch grass, J. C. BLEWBURY (*Gard. Chron., ser. 3, 21* (*1897*), *No. 524, p. 28*).—By plowing the land both ways when dry, and thorough harrowing, the grass, etc., being removed and burned and then seeded to barley or wheat, the author claims to have eradicated couch grass.

DISEASES OF PLANTS.

A new disease of the peach, W. G. JOHNSON (*Maryland Sta. Bul. 42, pp. 152, 153, figs. 2*).—During the work of inspecting the nurseries of the State, the author has on three occasions observed peach seedlings in an unhealthy condition. The trees affected had a characteristic reddish tinge, said to be due to the coloration of the underside of the leaves, which have a tendency to roll upward and inward, exposing the under surface. The reddish tinge first appears on the outer edge, gradually spreading over the entire surface, giving the trees a decided reddish appearance. So far, the cause of the disease has not been ascertained, and as no fungus or bacterial parasite is observed it is thought to be probably due to soil conditions resulting in imperfect nutrition. Whether the disease is communicable by budding is under investigation, as well as other points concerning the vitality and longevity of diseased trees. Experiments have also been undertaken to see whether the diseased condition can not be remedied by treating the soil with lime to neutralize the acidity, and stable manure or some commercial fertilizer to supply nitrogenous material. It appears that the disease is worst in acid soils, and such should be avoided in planting.

Plant diseases, C. W. WOODWORTH (*California Sta. Rpt. 1895, pp. 231–240*).—Notes are given on crown knot, trunk kernel, twig knot, powdery bark, gum disease of citrus trees, gum disease of stone fruit, root rot, sour sap, blight or die-back, leaf curl, and pear and apple scab, and the effect of alkali and of moss on orchard trees.

The conclusions given in Bulletin 99 of the station (E. S. R., 4, p. 563) relating to crown knot having been questioned, the author presents additional evidence based on results of extensive experiments on this disease. It is maintained that the disease is entirely distinct from any other and may be successfully treated with fungicides. It does not seem to be connected in any way with external conditions, and may be absent for a considerable time, then suddenly appear and as suddenly disappear. One of the earliest observations of the disease is its occurrence on plow wounds, and it is said to be certain that there is no similarity between normal healing of the wound and the crown knot.

Experiments with the woolly aphis show that the disease may be spread by insects to the roots of seedling apples.

A form of disease somewhat similar to crown knot, but confined entirely to the trunk and larger branches, is called by the author trunk kernel, and is briefly described. The injury which it produces seems to be confined to the roughening of the bark.

A twig knot of quinces, which is frequently mistaken for crown knot, is briefly mentioned. It is said to be a normal state of certain varieties.

The disease called powdery bark is said to be quite common in California. It is characterized by the drying up and cracking of the outer bark, exposing a layer of the inner tissue which readily breaks up into a fine powder. Beneath this powdery layer the bark may be either normal or dead. In case the bark is destroyed the branch usually dies also.

The gum disease of citrus trees is said to be one of the more serious troubles connected with citrus growing in many localities. It is considered to be of parasitic origin, although apparently not due to any particular organism but rather the combined action of several. Two forms are recognized, one originating at or near the crown and the other attacking the deeper parts of the roots. The latter form is also called root rot or foot rot and appears practically uncontrollable, while the former is said to be easily cured. The disease is said to originate only under unusual conditions of moisture and the presence of dead and decaying organic substances, it being only possible for the organism to enter a healthy tree through the intervention of decaying tissue. The remedy is to remove diseased tissues and keep the place exposed to the air and the tree will heal itself.

A brief note is given on the gum disease of stone fruit, which is a result of various causes, one of the most common being the attacks of one of the toadstool fungi. This disease seems to be uncontrollable. It is most prevalent in oak clearings, and generally a replanted tree will take the disease. The removal of a large amount of earth, lining the hole with iron or copper sulphate, filling it with new earth, and replanting has been accompanied by good results.

Sour sap and blight or die-back are considered of bacterial origin, and vigorous pruning and the use of fungicides are recommended as probably efficient means for their prevention.

Leaf curl of peach is briefly described, for which washes composed of lime, salt, and sulphur have been claimed to be efficient preventives. These and other washes were tested at the station with negative results. The use of winter washes, pruning, and summer treatment with Bordeaux mixture are recommended as probable means for keeping this disease in check.

The scab of apples and pears is briefly mentioned, and the use of Bordeaux mixture recommended for its prevention.

The effect of alkali on orchard trees is discussed, and the injuries are grouped as follows: (1) The burning of trees by excessive alkali which accumulates on the surface of the ground; (2) injury to the root hairs; (3) injuries caused by the accumulation of alkali salts in various parts of the plants; and (4) by the radiating power of alkaline soils, the strong radiation often seriously burning the edges of the leaves.

The effect of moss and lichens on trees, producing the injury generally known as hidebound, is described, and the use of winter washes containing caustic alkalies is recommended.

On the use of Jensen's hot-water treatment for millet smut, R. ADERHOLD (*Der Landwirth, 1896, No. 9; abs. in Bot. Centbl., 67 (1896), No. 9–10, pp. 310, 311*).—A comparison is made between the millet seed treated with copper sulphate solution and then limed, and seed subjected to the Jensen hot-water method for prevention of smut. It is stated that when the extra care and labor entailed by the hot-water treatment are considered the results do not warrant its recommendation as superior to copper sulphate and lime for the prevention of millet smut.

A new species of Puccinia on Polemonium cœruleum, C. STOERMER (*Bot. Notiser, 1896, p. 214*).

The cutting bench fungus, H. WEBER (*Florists' Exchange, 9 (1897), No. 9, p. 192*).—The author briefly describes the injury done to plants and suggests thorough ventilation and due regard to temperature as preventive means to be adopted.

A study of the gummosis of Aralia spinosa, L. LUTZ (*Bul. Soc. Bot. France, ser. 3, 3 (1896), No. 8, pp. 513–516*).

Yellowing of sugar beets, M. J. TROUDE (*Sucr. Indg., 1896, p. 338; abs. in Bot. Centbl., 69 (1897), No. 2–3, p. 82*).—A description is given of a yellowing of the foliage of sugar beets in June. The cause was thought to be physiological and is to be investigated further.

Cladochytrium pulposum parasitic on sugar beets, P. VUILLEMIN (*Bul. Soc. Bot. France, ser. 3, 3 (1896), No. 8, pp. 497–505*).—This parasite is considered as probably the same as the *Œdomyces leproides* of Trabut and in addition to attacking the sugar beet it is reported as being parasitic on *Atriplex patula, Chenopodium rubrum, C. urbicum,* and *C. glaucum,* as well as the wild *Beta vulgaris* in Algeria. The author states that the analogy claimed to exist between this fungus and the Ustilaginæ is without foundation in fact.

Notes on beet pests in 1896, M. HOLLRUNG (*Ztschr. Ver. Rübenz. Ind., 1896, Dec., pp. 928–938*).

The bacteria of sugar cane, DEBRAY (*Compt. Rend. Soc. Biol. Paris, 1896, Nov. 11*).

An apple disease, E. PRILLIEUX (*Bul. Soc. Bot. France, ser. 3, 3 (1896), No. 8, p. 600*).—Notes are given on a peculiar watery or vitreous appearance of apples, often two-thirds of the surface being involved. Examinations were made and bacteria cultivated from some of this abnormal tissue, and it is thought that the disease is due to these organisms since the sound tissue sooner or later becomes infected.

Prune rust (*Pacific Tree and Vine, 13 (1897), No. 47, p. 162*).—Winter spraying with copper sulphate solution followed in summer with Bordeaux mixture or eau celeste and putting trees in good condition of growth by use of fertilizers are recommended as efficient means for combating this disease.

ENTOMOLOGY.

The black scale, C. W. WOODWORTH (*California Sta. Rpt. 1895, pp. 253–262*).—This troublesome pest the author treats at some length, giving a description and discussion of its habits and life history, the various causes of death, species of the genus, its economics and its destruction by parasites and diseases, as well as the fungus, black smut, that follows its attack.

In discussing the economics of the scale he divides the injuries done by it into 3 classes, *i. e.*, those caused by (1) the removal of sap, (2) injuring the plant through puncturing, and (3) the excretions of the insects, which with the dust that accumulates serve as a nidus for the growth of fungi.

The injury through the removal of sap occurs when the plant, in the hot climate of California, can least afford to lose even the smallest amount of moisture. Little injury is done by puncturing when the insects are few, but when they are so numerous as to surround the branch they practically affect the whole of the living tissue, throwing it into a passive or resting state. As a consequence the branch assumes the appearance commonly known as "hidebound," giving the tree a dried-up appearance. The injuries by the excretions are not all direct. The collections of excrement, dust, and fungi injure by hindering the action of the sun upon the chlorophyll of the leaf, thus interfering with the food supply of the plant; and furthermore by disfiguring the fruit, they reduce its market value and cause an expense for washing. Such injuries are serious in the case of citrus fruits and are very much in excess of the cost of the most expensive of remedies, namely, the gas treatment.

The cause of the death the author attributes largely to the attacks of disease. Parasites form a prominent factor in the destruction of the scale, but not so prominent a one as has been supposed.

"They take some part in the destruction of the black scale. The common native Chalcid is estimated by Professor Howard to destroy 75 per cent, but this only means that 3 out of 4 of those that came to adult size contained the parasite; that is, less than 1 per cent of those hatched. I have never known of a case where more than 2 per cent were destroyed from this cause. The other 98 per cent met some other fate. . . .

"The black scale is very subject to disease. The diseases seem to be similar to, if not identical with, those which destroy the chinch bug in the Mississippi Valley. On a tree well infested with black scale, I have seldom met with a death rate of less than 90 per cent, evidently from this cause, occurring between the time the eggs are laid to the time of the second moult.

"There is a considerable number that crawl down the trunk, or drop from the tree, and occasionally there is a wholesale destruction due to a hot, dry wind, or some such meteorological condition.

"The number ordinarily destroyed by ladybirds is much smaller than is usually supposed. Ladybirds and their larvæ are to be met with more abundantly in other situations than in scale-infested trees; indeed it is the exception to find them particularly abundant on such trees. On the University grounds in Berkeley, the only

case of particular abundance of ladybird larvæ on a tree infested by any kind of scale insects, which has occurred during a period of 5 years, was a carob tree infested with the greedy scale, which had for 2 seasons a great many "twice-stabbed ladybird" larvæ, and which is still scaly. The fact is quite observable that the beetle of the *Rhizobius ventralis* feeds by choice, if not entirely, on the diseased larvæ of the black scale; and it is also true that the whole family are closely allied with, and doubtless derived from, fungus-eating beetles. So it may be that the ladybirds only do well on insects made palatable by the attack of certain bacteria or fungi. . . .

"It is a fact that the Rhizobius has been present in trees in which there has been a notable decrease in the abundance of the black scale; but it is also true that it has been present in about equal numbers, at the same time, in neighboring trees in which there was no decrease in the black scale. It is incontestably the fact that in the city of Santa Barbara, where the Rhizobius has been allowed to have its own way, and where it has been very abundant for more than a year, there is to-day a larger amount of black scale than at Berkeley, where there has been no spraying for 3 years, and where the Rhizobius has not been able to secure a foothold. The black scale does not do quite as well at Berkeley, perhaps, as at Santa Barbara, but I have seen some trees here that were as badly affected as any I have met with anywhere.

"Almost every case investigated, where wonderful results were claimed for the Rhizobius, proved that, though the Rhizobius may have been present, it could have been only an extremely small factor in the results obtained."

At the end of the paper there is given a brief discussion of several remedies, the most thorough of which is the gas treatment, and the cheapest that by resin soap mixture. But the most important method of all, the author points out, lies along the line of keeping the tree in a condition in which the insect can do no injury; and for this, careful watching of the tree and a quick appreciation of the evidence of distress are necessary. The introduction and fostering of predaceous and parasitic insects of all sorts and of diseases is nevertheless important.

Entomology, C. W. WOODWORTH (*California Sta. Rpt. 1895, pp. 240-249*).—This report is made up from correspondence and discussions of the more common insect pests, with suggestions as to remedies.

In the case of cutworms, Paris green used in poisoning bait such as bunches of grass or other green stuff which is to be scattered about the field is recommended; but in the case of the climbing cutworm it may be applied in the form of a powder, at the rate of 5 lbs. per acre.

For Diabrotica, which was injurious in different portions of the State, the author suggests that the use of some decoy plants might form the most promising mode of treatment. In the case of the corn worm, dusting the field with Paris green either before or just at the time the silk appears is suggested as a remedy.

Tettigonia may be most readily destroyed by jarring the insects to the ground and then sprinkling them with a resin soap mixture by means of watering pots.

The peach moth is mentioned more especially "to call attention to a point in the life history of the insect, which is not so widely known, but which indicates the true remedy for the pest. It appears that the young larva attacks the branches of the tree during the winter, eating through the bark and causing a drop of gum to exude in a number of

places, before it attacks the bud in the spring. The proper remedy, therefore, would be to poison the bark and the outside of the branches during the winter or toward spring, thus killing the insect before it does its chief injury by attacking the buds."

Dendrolene, J. B. Smith (*Garden and Forest, 10 (1897), No. 463, pp. 8, 9*).—In the spring of 1896 it was found that the Dendrolene previously applied to some peach trees had penetrated the bark sufficiently to kill the cells and consequently to stop the circulation of the sap. In some instances the effect was like that of a tight band around the trunk. Young trees were most affected. It is suggested that (1) some ingredient be mixed with Dendrolene to lessen its penetrating power; (2) it should not be applied to young trees without considerable caution, and (3) in no case should the application be a permanent one.

Tests of insecticides, E. S. Goff (*Wisconsin Sta. Rpt. 1895, pp. 307–310*).—Experiments were made with 4 insecticides submitted to the station: (1) Oriental Fertilizer and Insect Destroyer, (2) Antinonnin, (3) West's Chloronaphtholeum, and (4) Siebner's Potato Bug Exterminator Compound, with the result that none of them can be said to have any special value. In the case of the first three, only the Antinonnin can be depended upon as a remedy against either sucking or leaf-eating insects, and this injures the plants to such an extent that it is worthless for general use. In each case the directions given in the circulars were followed, but the compounds proved worthless when so used. Their strength was doubled, but without materially changing the results. In the case of the fourth compound, careful comparison with control experiments proves it to be worthless so far as preventing the attack of the beetle is concerned.

On a bacterial disease of the squash bug (Anasa tristis), B. M. Duggar (*Illinois State Lab. Nat. Hist., 4 (1896), pp. 340–379, pls. 2*).—The subject of this bulletin was presented before section "G" of the American Association for the Advancement of Science.[1] The disease was observed during July, 1895, while studying some fungus diseases of the chinch bug, a great many squash bugs being employed as more convenient on account of size. Squash bugs kept in breeding cages in the laboratory were observed to be dying in considerable numbers. A fresh lot taken from the field July 23 was put into breeding cages, fragments of the dead bugs from the first outbreak being scattered in one cage and the others kept under normal conditions. Within 3½ days one-half of the bugs in the infested cage were dead, while in the control experiment with many more individuals only two or three died. A few hours previous to death the insect becomes sluggish and often incapable of crawling without a marked drag. Finally a slight movement of the antennæ and legs is the only sign of life. As death approaches, the insect becomes slightly darker in color. After

[1] Science, 4 (1896), No. 91, p. 432 (E. S. R., 8, p. 242).

death the nymph rapidly assumes a deep purplish-black hue, the body appears swollen, and in the course of 24 hours or more becomes a sack of gruel-like fluids. It can not then be easily lifted without breaking. In adults at death, the body has a moist appearance, especially in the cephalic region of the ventral surface of the abdomen. Later this appears evident throughout, but the chitinous crust does not collapse and unless broken the offensive fluids within are not noticed. The odor is characteristic, being more pronounced and putrefactive than that of the normal squash bug.

A microscopical examination showed short bacilli, single or in pairs, measuring 1.2–1.8μ by 0.6–0.8μ, some of which stained homogeneously and others more deeply at the poles.

As to the general distribution of the bacilli within the body, in bugs at the time of death the microörganisms are to be found in great abundance in all parts of the perivisceral cavity and are well differentiated from the blood coagulum. Besides the muscles and the stout walls of the alimentary organs, very few structures of the organism are unattacked. Investigation showed that the bacteria probably gained entrance through the spiracles.

Cultures of the microörganisms obtained from dead insects and from the body fluid of a sick nymph showed it to be both aërobic and facultative anaërobic, and that it liquefies gelatin. Its characteristics and growth are described in some detail. It grows well at living-room temperature, but is easily killed by high temperatures, an exposure to 125° F. for 1 hour on 2 successive days or for 2 hours on 1 day proving fatal. The optimum temperature proved to be between 83 and 90° F. Experiments indicate that the organism is not attenuated by continuous growth in the laboratory.

Infusions from cultures on agar evidently contain a toxic principle which was found fatal to many insects, including water beetles, immersed in it.

In the inoculation experiments infusions of the dead bugs together with both fresh and old isolation cultures were employed. In all cases control experiments were carried on in both field and laboratory with *Anasa tristis* and *Blissus leucopterus*. It was found that *Bacillus entomotoxicon* is very readily communicated, especially to the young bugs, and judging from the author's tables infusions of the dead bugs are the best material for inoculation. In experiments with grubs and larvæ of other insects, external application of infection material did not give successful results.

A copious bibliography is given.

Notes from the entomological laboratory, C. W. WOODWORTH (*California Sta. Rpt. 1895, pp. 249–253, pl. 1*).—Suggestions are given for various pieces of entomological apparatus—a folding net, setting board, labels, glass and metal insect boxes, dissecting dish, labels for slides, slides for cover mounts, books for cover glass mounts, racks for bottles and pocket compound microscope, being the subjects.

The most notable of the suggestions are: (1) The use of small labels bearing map sketches printed in pale ink so that the locality where the insect is obtained may be indicated by a small dot. When the box is full of such labels an idea of the geographical range of the insect may be obtained at a glance. (2) Instead of the usual label the use of thin pieces of tissue paper upon which the number is written and the paper mounted under the glass with the object. In the case of balsam the paper becomes transparent, leaving the number clear and distinct. The forms of the labels, which are of two sizes, are illustrated.

On the Mexican bees of the genus Augochlora, T. D. A. COCKERELL (*Canadian Ent. 1897, Jan., pp. 4–6*).—Table of species. New subgenus Augochoropsis. New spp., *Augochlora binghami* and *A. aurifera.*

The life histories of the New York slug caterpillars, II, H. G. DYAR and Miss E. MORTON (*New York Ent. Soc. Jour., 4 (1896), Nos. 1, pp. 1–9, pl. 1; 3–6, pp. 167–190, pls. 4*).

The asparagus fly, E. H. MEYER (*Braunschw. landw. Ztg., 65 (1897), No. 3, pp. 9, 10*).—A description of *Trypeta fulminans* and its life history, with a discussion of the best means of destroying it. For spring time the author advises the use of Raupenleim on strips of paper placed at intervals in the asparagus bed; and for fall, the burning of all rubbish.

Entomology: The codling moth, T. D. A. COCKERELL (*S. W. Farm and Garden, 1896, Dec., pp. 9, 10; Jan., p. 9*).—The codling moth question in the West. The use and injurious effects of dendrolene, and the distribution of the codling moth and its manner of spreading.

The grapevine beetle (Eumoplus vitis), K. SAJO (*Illus. Wochenschr. Ent., 1 (1896), Nos. 32, pp. 501–506, figs. 3; 33, pp. 517–524, figs. 5*).

The Lecaniums of California, MARY W. TYRRELL (*California Sta. Rpt. 1895, pp. 262–270, pls. 4*).—A systematic treatment of the common California Lecanii, discussing the similarities and differences between the species and giving the host plants in each case. An analytical synopsis is given to aid in determining the species. Nothing is said as to remedies.

Scale insects: Coccidæ associated with ants, T. D. A. COCKERELL (*Sci. Gos., 3 (1897), No. 33, pp. 239–241*).—The author enumerates 14 species. One new species, *Dactylopius kingii*, is described.

Coccidæ or scale insects, IX, T. D. A. COCKERELL (*Bul. Bot. Dept. Jamaica, 1896, Nov., pp. 256–259*).

The Palmetto scale, T. D. A. COCKERELL (*Garden and Forest, 10 (1897), No. 464, p. 19*).—The scale is thought to be a variety of *Aspidiotus sabalis* which the author calls *Aspidiotus sabalis mexicana* (E. S. R., 8, p. 609).

Notable appearance of some forest insects during the summer of 1896 in the region of Eberswalde, ALTUM (*Ztschr. Forst. und Jagdw., 29 (1897), No. 1, pp. 44–50*).—Notes on the occurrence and ravages of *Tortrix pomonana, Lophyrus pini, Hylesinus piniperda, H. palliatus, Bostrichus lineatus, Orgyia pudibunda, Chrysomela alni, Gastropacha pini, Liparis monacha, Trachea piniperda, Tidonia piniaria, Sphinx pinastri, S. nerii, S. convolvuli, Noctua flavicornis, N. genistæ, Acherontia atropos.*

Key to the German injurious bark beetles for the practical use of the forester, K. and G. ESCHERICH (*Forstl. naturw. Ztschr., 6 (1897), No. 1, pp. 7–23*).—A brief practical treatise on the more common injurious beetles of the subfamilies Scolytidæ, Bostrychidæ, and Platypidæ.

Destructive insects and methods of controlling them, II, W. G. THOMSON (*Amer. Gard., 18 (1897), No. 108, p. 37*).

Injurious and beneficial insects of forest, field, and garden (*Die schädlichen und nützlichen Insecten in Forst, Feld, und Garten. Vienna: H. M. Schmit-Göbel, 1896.*

Forest moths that have become orchard and garden pests, W. W. FROGGATT (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 757–759, pls. 2*).—Notes are given of the painted acacia moth (*Teia anartoides*) and the gray-streaked moth (*Prodenia littoralis*).

A cure for onion grub, J. CRAWFORD (*Garden, 51 (1897), No. 1314, p. 54*).—Charcoal dust is spread over the onion plat to the depth of one-half inch and well worked into the top layer of soil.

Flooding woods as a means of destroying the "ground," as well as other insects injurious to forests, L. ANDERLING (*Ent. Nach., 22 (1896), No. 13–14, pp. 193–200*).

Ermisch's caterpillar lime, J. B. SMITH (*Amer. Gard., 18 (1897), No, 111, pp, 98–99*).

Experiments against Chrysomelidæ and Pyralidæ, CHARLIER (*Prog. Agr. et Vit., 26 (1896), No. 52, pp. 711–713*).

Fumigating greenhouses with hydrocyanic-acid gas, P. H. DORSETT (*Florists' Exchange, 9 (1897), No. 7, p. 147, figs. 3*).—Directions are given for fumigating with this gas, the amount required, and precautions to be observed. It is very efficient in killing aphides.

Analyses of Paris green, E. W. HILGARD (*California Sta. Rpt. 1895, p. 137*).—The percentages of arsenious acid in 2 samples are reported.

On the Diptera of St. Vincent (West Indies), S. WILLISTON (*Trans. Ent. Soc., London, 1896, III, pp. 253–447, pls. 7*).—The Dolichopodidæ and Phoridæ, by J. M. Aldrich.

Studies on the Muscidæ of France, II, L. PANDELLE (*Rev. Ent., 15 (1896), Nos. 1–8, 10, pp. 231*).

List of exotic Orthoptera described by S. H. Scudder, 1868–'79, with a revision of their nomenclature, S. H. SCUDDER (*Proc. Bost. Soc. Nat. Hist., 27 (1896), pp. 201–218*).

The study of the Braconidæ with a revision of the European and allied species of the genera Vipio and Bracon, O. SCHMIEDEKNECHT (*Illus. Wochenschr. Ent., 1 (1896), Nos. 31, pp. 496–498; 32, pp. 510–513; 33, pp. 527–530; 34, pp. 540–543; 35, pp. 557–559; 36, pp. 570–573; 37, pp. 589-592*).

Synopsis of the species of the Nysson inhabiting America north of Mexico, W. J. FOX (*New York Ent. Soc. Jour., 4 (1896), No. 1, pp. 10–16*).

Termites in captivity in England, G. D. HAVILAND and D. SHARP (*Trans. Ent. Soc. London, 1896, IV, pp. 589–594*).

Some new points of similarity between the larval nests of Trichoptera and the larval cases of Lepidoptera, likewise instances of protective mimicry in the cases of the larvæ of Trichoptera, R. STRUCK (*Illus. Wochenschr. Ent., 1 (1896), No. 39, pp. 615–619, figs. 6*).

Impressions received from a study of our North American Rhopalocera, H. SKINNER (*New York Ent. Soc. Jour., 4 (1896), No. 3, pp. 107–118*).

An evergreen pest from the Noctuidæ, H. GAUCKLER (*Illus. Wochenschr. Ent., 1 (1896), No. 35, pp. 554–557, figs. 3*).

Notes on seasonal dimorphism in South African Rhopalocera, A. K. MARSHALL (*Trans. Ent. Soc. London, 1896, IV, pp. 551–567*).

FOODS—ANIMAL PRODUCTION.

Examination of oil meals, F. W. WOLL (*Wisconsin Sta. Rpt. 1895, pp. 64–85, figs. 2*).—The author describes the manufacture of old-process and new-process linseed meals, and gives analyses of 12 samples of old-process and 5 samples of new-process meal sent to the station for examination, and partial analyses of a considerable number of samples.

Artificial digestion experiments were made with 12 samples of old-process and 9 samples of new-process meal. The average digestibility

of the protein of the former was found to be 94.3 per cent, and the range from 89.8 to 96.5 per cent; the average of the latter was 84.1 per cent, and the range from 79.8 to 86.6 per cent.

"We notice that the digestion coëfficients of the new-process meal came below those of the old-process meal in every instance, the average difference being 10.2 per cent. These results substantiate those obtained by direct digestion experiments with animals, but give greater advantage of the old-process meal. . . .

"On the basis of the digestion coëfficients found by the writer for old and new-process linseed meal, the content of digestible protein in the 2 kinds of oil meal will be as follows: Old-process, 33.8 per cent; new-process, 31.9 per cent."

The power of absorption of water was tested with a number of samples of old and new-process meal, and the starch content was also determined. When stirred with water the seed coat of flax will absorb the water and swell up, forming a mucilaginous mass. The old-process meal retains this characteristic, and shows it in a more marked degree, owing to the absence of the large excess of oil in the meal. In the manufacture of new-process meal this property is largely destroyed, "possibly because [absorption] takes place during the steam cooking of the mixture in the percolators." In making the test, 5 gm. of finely ground meal was mixed with 50 cc. of boiling water in a cylinder graduated to 50 cc. The whole was stirred and shaken. The cylinder was left for 2 hours, and the amount of clear liquid, if any, remaining on top was read off.

"The swelling test, therefore, gives decisive information concerning the process by which the meal is manufactured, and is in this respect of considerable value. Our knowledge of the subject does not, however, warrant us in basing any opinion as regards the comparative feeding value of the 2 kinds of meal on the quantity of water absorbed by the meal, as is often done in pushing the sale of one kind at the expense of the other."

The various materials used to adulterate linseed meals are discussed, as well as the comparative value of old and new-process meals.

The author insists on the need of purchasing meals of guarantied composition.

The fat in meat, E. BOGDANOW (*Pflüger's Arch. Physiol., 65 (1896), No. 1–2, pp. 81–89*).—This is a more extended account of work previously reported (E. S. R., 7, p. 919). The author made a number of experiments, from which the following conclusions were drawn:

Two kinds of fat exist in meat, which are characterized by the very different quantities of fatty acids which they contain. The amounts of fatty acids in each are fairly constant. One fat, which is easily extracted, is the fat obtained by the ordinary methods of analysis. The second fat, which can be extracted only with difficulty, is found in the muscle plasma and is called by the author muscle-plasma fat.

Investigation of food materials, M. E. JAFFA (*California Sta. Rpt. 1895, pp. 140–160*).—The principles of cattle feeding and the terms used are reprinted from Bulletin 100 of the station (E. S. R., 4, p. 732). Analyses of a number of additional California feeding stuffs are given,

including snail clover (*Medicago turbinata*), *Modiola decumbens*, alfileria (*Erodium cicutarium*), sachaline (*Polygonum sachalinense*), alfalfa, Australian saltbush (*Atriplex semibaccatum*), wheat hay, barley hay, wild yellow clover, Bokhara clover, Australian saltbush hay, wheat, wheat bran, wheat middlings and screenings, rice bran, cocoanut oil-cake meal, cotton-seed meal, and sugar-beet pulp.

The food value of fruits for live stock is discussed at some length, and analyses of a number of fruits are quoted. Fruits are deficient in protein, and the author advises using them to supply the fattening elements of food, and to make up the deficiency of nitrogenous matter by the use of substances like cotton-seed meal or cocoanut meal. A table is given showing the comparative value of fruits and a number of other feeding stuffs.

"When there is no market for the fruit there is sometimes nothing left to be done but to feed it to stock. Under any circumstance, when stone fruit is used as fodder for hogs, it is to be feared that when the animals crack large quantities of pits poisoning may occur from the oil of bitter almonds and the prussic acid present in the kernels. Precaution in this direction is unnecessary for cattle and horses, as they do not crack the pits. The stones or pits can be used to great advantage as fuel."

Farm grains for fattening lambs, J. A. Craig (*Wisconsin Sta. Rpt. 1895, pp. 46–48*).—The value of corn, corn and oats, corn and peas, and corn, peas, and oats as the grain portions of a fattening ration was tested with 20 Shropshire lambs, divided into 4 lots of 5 each. The lambs were selected from about 2,000, as representing the average lambs used for feeding purposes in Wisconsin. They were 9 weeks old at the beginning of the test, which lasted 8 weeks. Lot 1 was fed corn meal; lot 2 corn and oats; lot 3 corn and peas; and lot 4 corn, peas, and oats, and all received hay. The total gain of lot 1 was 104.5 lbs.; of lot 2, 85.5 lbs.; of lot 3, 126 lbs.; and of lot 4, 120.5 lbs. With hay at $8 per ton, and corn at 40 cts., oats at 30 cts., and peas at 60 cts. per bushel, the cost of 100 lbs. of gain of lot 1 was $4, of lot 2 $4.95, of lot 3 $4.21, and of lot 4 $4.54.

"A comparision of all the results indicates that for profitable feeding corn is certainly most conducive to gain, but, considering all things, the safety of the sheep and the profit as well, the mixture of corn and peas is superior to any mixture tried in this experiment."

Corn meal, bran, and oats for lambs before and after weaning, J. A. Craig (*Wisconsin Sta. Rpt. 1895, pp. 40–45, fig. 1*).—The value of corn meal, oats, and bran as a food for lambs before and after weaning was tested with 18 grade Dorset lambs, divided into 3 equal lots. The lambs were about 2 months old at the beginning of the test, which continued 8 weeks. Lot 1 was fed corn meal, lot 2 whole oats, and lot 3 bran. During the day they were allowed to run in a pasture, with 9 ewes, but were fed in a small inclosure. After weaning the feeding was continued on the same rations fed *ad libitum*. The

results of the feeding before and after weaning are tabulated, and the following conclusions are drawn:

"(1) Corn meal is indicated to be decidedly better than oats or bran for feeding lambs before and after weaning in respect to the rate of grain, cost of gain, and the amount required to produce 100 lbs. of increase. These features are decidedly the most important to consider in determining the position of such foods in an experiment of this kind.

"(2) Oats fed in a whole condition, considering the rate of gain and amount required to produce 100 lbs. increase, rank superior to bran as a food for feeding lambs over such a period. While seemingly inferior to oats for lambs before they are weaned, bran was decidedly better when fed to the same lambs on pasture after weaning.

"(3) Bran from the three points of view already stated has not given as good results as either of the other foods. The cost of the bran may vary in different localities so as to modify these results somewhat, but the valuation which has been adopted will likely represent the average. To make the position of these two foods more clearly evident it will be necessary to obtain more data bearing on their value for lamb feeding."

Succulent and dry rations for fattening lambs, J. A. CRAIG (*Wisconsin Sta. Rpt. 1895, pp. 61–63*).—The experiment was made with 12 grade Shropshire wethers, divided into 3 lots of 4 each, and lasted 11 weeks. Lot 1 was fed roots, hay, and grain; lot 2, silage, hay, and grain; and lot 3, hay and grain only. The same kind of grain was fed to all the lots, being oats at first, later oats and corn, and finally oats, corn, and linseed meal.

The total gain of lot 1 (roots) was 109.5 lbs., of lot 2 (silage) 102 lbs., and of lot 3 (hay) 116 lbs. The cost of 100 lbs. of gain for lot 1 was $6.13, lot 2 $6.22, and lot 3 $6.25. The financial statement is based on hay at $8, roots and silage at $2, and linseed meal at $25 per ton, and corn at 40 cts. and oats at 30 cts. per bushel.

"It will be seen that the lambs fed the dry ration gained slightly more than either of the others, but they ate more food, consuming more hay and much more grain than the other 2 lots. Considering the rate of gain the dry ration gave the highest returns, while next to it comes the root ration and lastly the silage ration. These gains, however, are very uniform, and indicate the trend of the experiment from the beginning until the conclusion."

From a financial standpoint, the roots were rather more profitable.

Wheat as food for swine, W. A. HENRY (*Wisconsin Sta. Rpt. 1895, pp. 24–31*).—Four tests of the value of wheat as food for swine are reported. The first test, which lasted 10 weeks, was made with 6 pure-bred Berkshire pigs divided into 2 equal lots. They were about 5 months old at the beginning of the trial, and had previously been fed upon a mixture of corn meal, shorts, and linseed meal with skim milk. Lot 1 was fed a ration of ground wheat, and lot 2 ground wheat and corn meal, half and half. The meal was mixed into a thick slop with water. In this and the other tests there was a preliminary period of 1 week. The food consumed per lot and per 100 lbs. of gain in weight, and the weekly and total gains for each pig are tabulated. Lot 1

(wheat) made a total gain of 191 lbs. and consumed 510 lbs. of food per 100 lbs. of gain; and lot 2 (wheat and corn) gained 197 lbs. and consumed 502 lbs. of food per 100 lbs of gain.

The second test was a duplicate of the first. Lot 1 made a total gain of 210 lbs. and consumed 502 lbs. of wheat per 100 lbs. of gain; lot 2 gained 216 lbs., and consumed 488 lbs. of corn meal and wheat per 100 lbs. of gain.

The third test, lasting 63 days, was with 6 Berkshire and 3 Poland China pigs about 9 weeks old at the beginning of the trial, and divided into 3 equal lots. Lot 1 was fed ground wheat; lot 2, corn meal and ground wheat, in equal parts; and lot 3, corn meal. Lot 1 gained 231 lbs. and consumed 522 lbs. of food per 100 lbs. of gain; lot 2 gained 250 lbs. and consumed 491 lbs. of food per 100 lbs. of gain; and lot 3 gained 243 lbs. and consumed 499 lbs. of food per 100 lbs. of gain.

The fourth trial was with 18 pure-bred Berkshire pigs divided into 3 equal lots, and lasted 18 weeks. The pigs had been on pasture during the summer and received a little corn each morning in addition. Lot 1 was fed ground wheat, lot 2 corn meal, and lot 3 wheat and corn meal in equal parts. The grain was mixed into a slop with water. Lot 1 gained 1,303 lbs. and consumed 465 lbs. of food per 100 lbs. of gain; lot 2 gained 1,213 lbs. and consumed 496 lbs. of food per 100 lbs. of gain; and lot 3 gained 1,323 lbs. and consumed 460 lbs. of food per 100 lbs. of gain.

The author summarizes the results of feeding various grains to pigs at the station and other stations in the United States and Canada, and concludes that corn meal and ground wheat "are practically equal to one another in the production of pork, about 500 lbs. of either being required to produce 100 lbs. of gain in live weight with hogs. When a mixture of the two, equal parts, is fed there is a slight saving, amounting to about 3 per cent by use of the mixture over either grain fed separately."

"Whole wheat can not be fed dry to hogs successfully. Wheat when soaked is very rarely satisfactory, much of the grain passing through the animal and appearing unbroken in the droppings. To secure the best results wheat should be ground and fed moistened with water or milk. Better yet, as our experiments show, it should be mixed with some other grain. In the West this will usually be corn meal. For pigs and shoats wheat is undoubtedly superior to corn, because it contains more muscle and bone-building components.

"In considering whether to feed wheat or sell it, the farmer should remember that each load of wheat sold from the farm carries off a very considerable amount of fertility, which may be largely saved by feeding."

The value of creamery separator skim milk for swine feeding, W. A. Henry (*Wisconsin Sta. Rpt. 1895, pp. 7–23*).—Eight feeding trials are reported in which skim milk from the university creamery was fed in varying amounts with corn meal or corn meal and shorts. In several instances, for purposes of comparison, corn meal mixed with water to a slop was also fed. In all the feeding trials the test

proper was preceded by a preliminary period of 1 week. The results of the trials are tabulated, including the food eaten and the weekly and total gains made by each animal, and the food consumed per 100 lbs. of gain.

The first trial was with 12 grade Poland China pigs, divided into 4 lots of 3 each, and lasted 33 days. The pigs had previously been fed on whey and grain. The second trial was with 16 grade Berkshire and Poland China pigs, divided into 4 lots of 4 each, and lasted 3 weeks. The pigs were about 4 months old at the beginning of the trial. The third trial was with 2 lots of 10 pigs, the first 3 pigs in each lot being grades and the others pure bred. The trial lasted 9 weeks. For a month before the beginning of the trial the pigs had been fed on a mixture of milk, corn meal, and shorts. The fourth trial was with 1 lot of 8 crossbred Berkshire-Poland China pigs and lasted 55 days. The fifth trial was with 1 lot of 9 grade Poland China pigs and lasted 56 days. The sixth trial was with 9 Berkshire pigs, divided into 3 equal lots, and lasted 7 weeks. Previous to the experiment the pigs had been fed corn meal and shorts with skim milk. The seventh trial was with 4 Poland China pigs, divided into 2 uniform lots, and was of 7 weeks' duration. The eighth trial was with 12 grade Poland China pigs, divided into 2 equal lots, and lasted 10 weeks.

The results of the trials are briefly summarized in the following table:

Experiments in feeding skim milk to pigs.

	Gain in weight of lot.	Food consumed per 100 lbs. of gain.		
		Skim milk.	Corn meal.	Corn and shorts.
First trial:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1, 1 lb. corn meal to 4 lbs. skim milk	133	1,039	238	....
Lot 2, 1 lb. corn meal to 6 lbs. skim milk	92	1,794	271	....
Lot 3, 1 lb. corn meal to 2 lbs. skim milk	139	600	359	....
Lot 4, corn meal and water for 2 weeks, afterwards corn and shorts (1:1) and water	107	....	....	[1]403
Second trial:				
Lot 1, 1 lb. corn meal to 5 lbs. skim milk	101	1,111	238	....
Lot 2, 1 lb. corn meal to 3.4 lbs. skim milk	112	746	220	....
Lot 3, 1 lb. corn meal to 2 lbs. skim milk	145	379	200	....
Lot 4, corn and shorts (1:1) and water	101	....	....	322
Third trial:				
Lot 1, 1 lb. corn meal to 4 lbs. skim milk	785	1,249	313	....
Lot 2, 1 lb. corn meal to 6 lbs. skim milk	725	1,629	271	....
Fourth trial:				
Lot 1, 1 lb. corn or corn meal to 6 lbs. skim milk. (Corn was fed 15 days and corn meal 40 days)	490	1,262	[2]273	....
Fifth trial:				
Lot 1, 1 lb. corn or corn meal to 8 lbs. skim milk. (Corn was fed 14 days and corn meal 42 days)	571	1,871	[2]239	....
Sixth trial:				
Lot 1, corn meal and water	146	....	513	....
Lot 2, 1 lb. corn meal to 8 lbs. skim milk	172	1,584	198	....
Lot 3, 1 lb. corn meal to 4 lbs. skim milk	199	1,111	278	....
Seventh trial:				
Lot 1, corn meal and water	124	....	443	....
Lot 2, 1 lb. corn meal to 8 lbs. skim milk	150	1,483	185	....
Eighth trial:				
Lot 1, 1 lb. corn meal to 3 lbs. skim milk	614	893	316	....
Lot 2, 1 lb. corn meal to 6 lbs. skim milk	617	1,460	261	....

[1] Including corn meal. [2] Including corn.

The author summarizes the results of these experiments and similar experiments previously made at the station as follows:

Food consumed per 100 lbs. of gain in live weight in experiments with pigs.

	Pounds.
Grain only	506
1 lb. corn meal to 1–3 lbs. skim milk:	
Corn meal	321
Skim milk	585
1 lb. corn meal to 3–5 lbs. skim milk:	
Corn meal	265
Skim milk	1,048
1 lb. corn meal to 5–7 lbs. corn meal:	
Corn meal	250
Skim milk	1,434
1 lb. corn meal to 7–9 lbs. skim milk:	
Corn meal	207
Skim milk	1,616

"In the above we note that the largest saving of grain with a given amount of milk is effected where from 1 to 3 lbs. of milk are fed with each pound of corn meal; when larger amounts of milk are fed with the meal the milk appears relatively less valuable. The average of all trials shows that when feeding skim milk with corn meal 462 lbs. of milk effects a saving of 100 lbs. of meal."

On the basis of the corn saved when skim milk was fed, the author computes the value of skim milk when corn is valued at from $10 to $30 per ton. The maximum, minimum, and average value of skim milk on such a basis is shown in the following table:

Table showing the value of skim milk for pig feeding along with corn at different prices for the corn.

Value of corn.	Value of 100 lbs. of skim milk.		
	Maximum.	Minimum.	Average
	Cents.	*Cents.*	*Cents.*
$10 per ton (28 cts. per bushel)	16	9	11
$12 per ton (33.6 cts. per bushel)	19	11	13
$14 per ton (39.2 cts. per bushel)	22	13	15
$16 per ton (44.8 cts. per bushel)	25	15	17
$18 per ton (50.4 cts. per bushel)	28	16	19
$20 per ton (56 cts. per bushel)	32	18	22
$30 per ton (84 cts. per bushel)	47	27	32

In the author's opinion, skim milk, besides being an economical addition to a ration, improves its quality.

The need of securing skim milk of uniform quality and in clean vessels is insisted upon.

The influence of fine gravel upon the digestibility of millet by hens, J. KALUGIN (*Selskoye Khozyaistvo e Lyesovodstvo, 1896, No. 10; abs. in Fühling's landw. Ztg., 46 (1897), No. 3, pp. 85, 86*).—The author briefly reports an experiment of 3 periods with hens to test the effect of fine gravel upon the digestibility of millet. In 2 periods fine gravel was fed with the millet, and in 1 period it was omitted and powdered coal given instead. The conclusion was reached that fine gravel and

also powdered coal increased the coëfficients of digestibility of the nutrients, and especially those of protein and crude fiber.

Examination of miscellaneous fodders, F. W. WOLL (*Wisconsin Sta. Rpt. 1895, pp. 86–92*).—The author reports analyses of gluten feed, Buffalo feed, Argo gluten feed, cream gluten, hominy feed, Red Dog flour, wheat shorts, dried brewers' grains, oat hulls, ground feed, meat meal, rape, cotton-seed meal, and flour-mill sweepings.

Artificial digestion experiments by the Stutzer-Kühn method showed the following percentages of protein to be digested: Buffalo gluten feed 87.2, Argo gluten feed 93, gluten meal 93.5, and cream gluten 91.6.

Argon and nitrogen in blood, P. REGNARD and T. SCHLÖSSING (*Compt. Rend., 124 (1897), No. 6, pp. 302–304*).

Digestive ferments (*Diet. and Hyg. Gaz., 13 (1897), No. 3, pp. 155–160*).—A general discussion of the subject.

The bread eaters' catachism (*Jour. Hyg., 22 (1896), Nos. 1061, pp. 33, 34; 1062, pp. 46–48; 1063, pp. 57, 58; 1064, pp. 67–70*).—A discussion of bread, in the form of questions and answers.

Note on ammunition bread, A. CAMERON (*Analyst, 21 (1896), Oct. p. 255*).—The bread contained over 58 per cent of water, and was sour, spongy, and very dark in color.—B. W. KILGORE.

Composition of Quaker Oats, S. WEINWURM (*Ztschr. Nahr. Untersuch. und Hyg., 11 (1897), No. 2, p. 25*).—The author reports a microscopical and chemical analysis of Quaker Oats.

Concerning oatmeal (*Diet. and Hyg. Gaz., 13 (1897), No. 2, pp. 85–88*).—A general article discussing the proper use of oatmeal as an article of diet in health and disease.

Gluten flour, M. E. JAFFA (*California Sta. Rpt. 1895, p. 161*).—Analysis of a sample of gluten flour.

Digestibility of sterilized and pasteurized milk, BENDIX (*Jahrbuch für Kinderheilkunde; rev. in Diet. and Hyg. Gaz., 13 (1897), No. 2, p. 134*).

Milk and the feeding of infants, F. VAN EMELEN (*Le lait, et l'Alimentation des Nouveaux-nés. Brussels: M. Lamertin, 1896*).

On milk in general, with special reference to its use as a food for infants, J. G. ELLENBERGER (*Ztschr. Nahr. Untersuch. und Hyg., 11 (1897), No. 2, pp. 27, 28*).—A general discussion quoting the results of several investigators.

On the nutritive value of sterilized milk, RODET (*Compt. Rend. Soc. Biol. Paris, 1896, No. 19, pp. 555–558*).

The advantages of uncooked goats' milk for children, SCHWARTZ (*Milch Ztg., 1896, No. 44; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 25–26, p. 801*).

On the use of the flesh of tuberculous animals and its effect on health (*Ber. Sechste Internat. tierarztl. Kongress, 1896, p. 826; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, pp. 62, 63*).—The congress recommended that the flesh of tuberculous animals be sterilized before it is sold for food if there is any chance of its being consumed raw or rare, since there is danger in its use in the last two conditions.

Slaughtering and slaughter houses, T. BOURRIER (*Les industries des Abattoires. Paris: J. B. Baillière et fils, 1896; rev. in Jour. Hyg., 32 (1897), No. 1061, p. 35*).

Butter and butterine, M. E. JAFFA (*California Sta. Rpt. 1895, p. 160*).—Analyses of 2 samples of butter and 1 of butterine are given.

The utilization of molasses, P. BONAME (*Rap. Ann. Sta. Agron. Île Maurice, 1895, pp. 52–74*).—A discussion (accompanied by analyses) of the value of this material for food, fertilizer, fuel, and manufacture of salts and alcohol.

Preserved fruit as a daily article of food, W. C. GRASBY (*Garden and Field, 22 (1897), No. 8, p. 190*).—A popular article.

Note on ginger, T. P. BLUNT (*Analyst, 21 (1896), Dec., p. 309*).

Hydromel and the fermentation products of honey, J. B. DEPAIRE (*Hydromel et produits dérivés de la Fermentation der Miel. Brussels: M. Lamertin, 1896, pp. 71, pls. 3*).

Lead in a sample of Canadian cheese, F. W. STODDART (*Analyst 21 (1896), Aug., p. 208*).—The author found metallic lead in a brand of cheese much imported into England from Canada. The lead was distributed in veins, giving the cheese a bluish marbled appearance, and amounted to 1.25 grains of metallic lead per pound of cheese.—B. W. KILGORE.

Food colors (*Diet. and Hyg. Gaz., 13 (1897), No. 3, pp. 177-178*).—The conclusion is reached that there is no reason for regarding the standard coal tar colors as harmful in the quantities used, and that it is the duty of sanitary authorities to find out what colors are used and in what quantity.

The preservation of food, J. H. EGBERT (*Diet. and Hyg. Gaz., 13 (1897), No. 2, pp. 67-71*).—A general article discussing the subject from an historical standpoint.

The art of feeding the invalid (*London: The Scientific Press, Limited, pp. VIII, 264*).—After brief remarks on the food and diet of invalids the author discusses the diet suited to various diseases. Many recipes and methods of preparation of food for invalids are given.

Guide to the purchase of meat and meat products used for human food, G. MOSSELMAN and G. HEBRANT (*Guide der Consommateur, La Viande et les produits qué s'y rattechent dans l'Alimentation de l'Homme. Brussels: M. Lamertin, 1896*).

The table: How to buy food, how to cook it, and how to serve it, A. FILIPPINI (*New York: The Merriam Co., 1897, pp. 507, pl. 1*).—A cook book.

Peanut oil added to skim milk as a food for calves, M. PETERSEN (*Braunschw. landw. Ztg., 64 (1896), No. 49, pp. 200, 201*).—Experiments with about 20 calves showed that peanut oil of good quality may be fed with skim milk to calves with favorable results.

American experiments in the crossbreeding of cattle, J. EVERETT (*Deut. landw. Presse, 23 (1896), No. 103, p. 919*).

Grain feeding lambs for market, J. A. CRAIG (*Wisconsin Sta. Rpt. 1895, pp. 49-60, fig. 1*).—A reprint of Bulletin 41 of the station (E. S. R., 6, p. 661).

A dipping vat for sheep, J. A. CRAIG (*Wisconsin Sta. Rpt. 1895, pp. 32-39, figs. 4.*)—The author gives a detailed plan of construction for a large dipping vat with catching and dripping pens, and describes the method of dipping and the preparation of the dipping fluid. The dipping of swine is also discussed.

Poultry keeping for profit, F. E. HEGE (*North Carolina Sta. Bul. 130, pp. 205-260, figs. 40*).—The author discusses poultry houses, pure-bred poultry, diseases, anatomy of the egg, the egg during incubation, natural incubation, artificial incubation, feeding, broods and brooding, dressing and shipping poultry to market, and similar topics. Illustrations are given of the principal breeds of poultry, the egg at different stages during incubation, poultry houses, etc. Many quotations from other writers are included in this bulletin. It contains much information which will be of use to practical poultry raisers. Some of the author's brief summaries are as follows:

"Do not crowd 20 fowls into a house built for 10. Be sure and have the runs well sown to grass, clover, rye, or millet—the former preferred.

"Do not neglect to give the fowls fresh water at least twice a day in winter and three times in summer, and keep it in the shade during hot weather.

"Do not make the most common mistake of buying 'cheap' pure-bred fowls, for you will regret it sooner or later; *i. e.*, if you are breeding for points or exhibition fowls. The best and cheapest plan is to purchase eggs at from $2 to $3 per sitting from reliable breeders, and secure in the beginning something fine, or purchase young stock in the early fall from these same breeders.

"Keep all feeding troughs and drinking vessels wholesome and clean.

"When the fowls are molting they require more food, or rather stronger food, in order to grow the new feathers. Meat scraps and ground green bone are excellent, while a little linseed meal in their food daily will hasten the process and make the hens lay sooner."

The danger resulting from the use of peat as litter, E. THIERRY (*Jour. Agr. Prat., 1897, I, No. 5, pp. 173, 174*).—The danger is due to the habit which cattle especially acquire of eating the litter.

DAIRY FARMING—DAIRYING.

Investigation of the milk of 97 East Friesian cows from 7 herds in East Friesland as to the yield and fat content during one period of lactation, N. WYCHGRAM (*Bremen: M. Heinsius Nachfolger, 1897, pp. 52; abs. in Milch Ztg., 45 (1896), No. 48, p. 764*).—This investigation was made under the auspices of the East Friesian Breeders' Association. The Association selected the 7 herds for investigation. Samples of the mixed milk for one day were examined twice each month, the Gerber test being used. A large amount of tabulated data is given, arranged to show the fluctuations in the yield and fat content of the milk of individual cows as influenced by the stage of lactation, age, pasturage, and other conditions. The averages for the 7 herds were as follows:

Average yield and fat content of milk from 7 herds during one period of lactation.

	Yield of milk.	Fat content.
	Kg.	*Per cent.*
Herd No. 1	2,632	2.909
2	3,374	2.938
3	3,955	3.165
4	2,301	3.166
5	2,969	2.976
6	3,966	3.260
7	3,043	3.087

The relation between specific gravity and solids of milk, S. M. BABCOCK (*Wisconsin Sta. Rpt. 1895, pp. 120–126*).—In the Annual Report of the station for 1891 (E. S. R., 4, p. 189), the following formula is given:

$$\text{Solids-not-fat} = \left(\frac{100S - fS}{100 - 1.0753\ fS} - 1\right)(100 - f)\ 2.6$$

in which S = specific gravity of milk and f = percentage of fat.

From data accumulated the author now believes the constant 2.6 to be too large for the average milk of this country and that it should be reduced to 2.5, and he recommends the substitution of this in the above formula.

"In this formula it is assumed that the difference between the specific gravity of milk serum and that of water is directly proportional to the percentage of solids in the serum. This assumption is not quite correct and would lead to a slight error if the solids of the milk serum were always of the same composition, for in such case the specific gravity of the milk serum and the percentage of solids which it contained would change at different rates. . . .

"The error, however, from this source, with normal milks containing from 8 to 10 per cent of solids-not-fat, is small, amounting in no case to as much as 0.05 per cent, and this I believe is, in most cases, offset by changes in the composition of the milk solids. If there is no compensation of this kind the formula should in general give results too low with milks having less than the average percentage of solids in the serum and too high when these solids are above the average. I have not found this to be the case, as in a large number of comparative determinations with milks

differing widely in the amount of solids-not-fat over 70 per cent of the results obtained have been in the opposite direction.

"A possible explanation may be found in changes in the relative proportions of sugar and casein in milk. For the reason that a given amount of milk sugar increases the specific gravity of milk serum more than an equal amount of casein, it follows that a factor expressing the relation between specific gravity and solids in milk, of average composition, would not apply to milks where the ratio of casein to sugar differs from the average. In the above formula the factor 2.5 is for this reason a trifle too large for milk containing more than the average amount of sugar, compared to casein, and too small when the opposite is true."

The results by this formula are compared with those by the formula of Hehner and Richmond[1] and by Richmond's[2] new formula.

"Any of the 3 formulas mentioned in this paper will, in most cases, give satisfactory results for solids, especially as the error falls entirely upon the solids-not-fat where it is of comparatively little importance."

Tables are given prepared from the author's amended formula showing the per cent of solids-not-fat corresponding to lactometer readings from 26 to 36 and fat content from 0 to 6 per cent.

"An inspection of this table shows that the percentage of solids increases practically at the rate of 0.25 for each lactometer degree and 0.02 for each 0.1 per cent of fat. This relation is expressed by the simple formula:

$$\text{Solids-not-fat} = \tfrac{1}{4}\,L + 0.2\,f \text{ and}$$
$$\text{Total solids} = \tfrac{1}{4}\,L + 1.2\,f.$$

in which L = Quevenne lactometer reading and f = percentage of fat. . . .

"It gives results which differ not more than 0.04 from those of the complete formula for milks containing up to 6 per cent of fat, and has the advantage that it can be easily and quickly applied without tables."

Notes on pasteurization of milk and cream, H. L. RUSSELL and F. W. WOLL (*Wisconsin Sta. Rpt. 1895, pp. 158–173, pl. 1*).—*Bacteriological investigations, H. L. Russell*, (pp. 158–164).—Bacteriological studies were made of the milk and cream pasteurized in the apparatus described in Bulletin 44 of the station (E. S. R., 7, p. 987). A brief summary of the results is given in the following table:

Number of bacteria per cubic centimeter in milk and cream.

	Samples examined.	Unpasteurized.			Pasteurized.			Average reduction.
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
								Per cent.
Full cream milk[1] ...	50	25,300	15,827,000	3,674,000	0	37,500	6,140	99.832
25 per cent cream...	58	425,000	32,800,000	8,700,000	0	57,000	24,250	99.722

[1] Whole milk.—ED.

"The cream either in the pasteurized or raw condition is invariably richer in bacteria than the milk. This is particularly true in the case of the unpasteurized material. The cultures made from pasteurized milk often contained so few bacteria that it may be said to be almost sterile. In 40 per cent of samples examined the

[1] Analyst, 13, p. 26.

[2] U. S. Dept. Agr., Division of Chemistry Bul. 43, p. 181 (E. S. R., 6, p. 614).

number of bacteria per cubic centimeter was less than 1,000. In the case of pasteurized cream this was true in only 3 instances out of 29 (10 per cent). . . .

"In only exceptional instances (not more than one or two in the entire set of analyses) did the reduction in numbers fall below 90 per cent, showing that the absolute percentage of spores compared with growing vegetating forms was very small. This proportion, however, is very largely dependent upon the manner in which the milk is treated. If careless methods of milking prevail and much foreign matter, such as dirt and particles of excreta, be allowed to gain access to the milk, the number of spores in the milk is very much increased. This is another foundation for the old argument of the effect of scrupulous cleanliness—a doctrine so old and so often heard that it often falls unheeded to the ground."

The effect of the age of the milk on the presence of spores is discussed. When the milk was received and handled promptly at the creamery there was a much smaller number of organisms in it than when it was from 30 to 42 hours old before handling, and the same was true even in a more striking manner of the cream. Pasteurized milk and cream showed only a few bacteria when made from fresh milk, but contained considerable numbers of organisms when made from milk kept from 1 to 2 days.

"Data of this sort show that the age of the milk and the bacterial development dependent upon this age account for the shorter keeping qualities of the milk secured under the more unfavorable winter conditions. This increased growth produces naturally many spores, and therefore milk of this sort pasteurized with the same care can not be expected to keep as well as that which is handled in a fresher condition where there are less bacteria in the spore or resistant form."

Rejecting those species that occurred only sporadically in the cultures, 15 different forms of bacteria were isolated from normal milk and cream, 6 of which predominated in a large degree. Of these 15 forms, 3 species produced lactic acid, 7 species caused no apparent change in the milk, and 5 species coagulated the milk by the production of rennet and subsequently digested the curdled casein. In the same milk after pasteurizing, only 6 species were isolated, 3 of which had no apparent action on the milk, while the remaining 3 curdled the milk by the formation of rennet and subsequently digested the same by the action of a tryptic enzym. The species producing lactic acid were entirely destroyed by pasteurizing. The species producing little or no acid are believed to be derived from extraneous sources and to be associated with dirt and excreta gaining access to the milk during the milking.

"As these organisms that are thus associated with filth of various kinds are able to persist in pasteurized milk by virtue of their spores, it emphasizes the well-known lesson that scrupulous cleanliness is an absolute essential in dairies that pasteurize their milk for direct consumption. Cleanliness in milking diminishes materially the amount of this class of bacteria that gains access to the milk."

The effect of pasteurization and sterilization on the viscosity and fat globules of milk and cream, F. W. Woll (pp. 164–173).—The object of this investigation was to determine if possible the reason why milk or cream heated to pasteurizing temperatures, or even lower, and subsequently cooled gives the appearance of being thinner than before and

does not appear as rich as it really is. It has been suggested that it may be due to the fat globules of the milk and cream being split up by the digestion and heat; and consequently the influence of heat on the fat globules and the viscosity of the milk and cream was studied. Whole milk, cream, skim milk, and whey were used, the number and size of the fat globules, the viscosity, and the specific gravity being determined in the samples before pasteurizing, after pasteurizing, and after subsequent sterilization. In some cases the effect of heating at a lower temperature than that for pasteurizing and the effect of beating with an egg beater were also studied. The data for these observations are fully tabulated.

"All determinations of viscosity in pasteurized or sterilized milk or cream have shown a decided influence of heat on the viscosity coëfficient, the viscosity being lowest in every case where the products were subjected to a temperature of 65° or above; this influence is noticeable almost as distinctly in the outward physical appearance of the cream as shown by the viscometer tests; cream which would have the appearance of being very thick before being warmed appears to be of only average thickness after having been heated, flowing readily from one vessel to another. . . .

"The viscosity of the milk was not affected by the application of heat under 30° C., but there was a distinct decrease in viscosity at 30° and still more at 35°, as is shown in case of sample B, where sufficient acid had not yet been developed to cause an increase in the viscosity. The changes in the physical properties of cream (and presumably also of milk) brought about by the application of heat therefore occur even at temperatures below that of the melting point of butter fat. . . .

"The influence of pasteurization [of centrifugal skim milk] is shown in a uniformly lower viscosity in the pasteurized samples; subsequent sterilization, on the other hand, is seen to increase the viscosity, possibly on account of coagulation of the milk albumen; while the results obtained after the first and the second sterilization are practically the same, there is an increase after third sterilization, with stationary results after this determination. . . .

"The increase in viscosity [of whey] both in the pasteurized and the sterilized samples in this case must be attributed to the precipitation of albumen; this takes place partly, in a very finely divided state, in heating the sweet whey to 65° C., but at sterilization the precipitation is apparently complete, a heavy white flocculent precipitate being formed which greatly interferes with the rotation of the viscometer cylinder. Any influence that the heat may exert on the viscosity of whey will not therefore be apparent from the results obtained by following the present method."

The author concludes that the investigation does not show the cause of the characteristic influence of heat on the physical condition of milk and cream, but since it is also apparent in milk nearly free from fat (centrifugal skim milk) as well as in full milk and cream, and since the changes occur even below the melting point of milk fat, he believes that this change from pasteurizing can not be attributed to the fat globules. He suggests that these changes may be due "to the unstable character of the nitrogenous or the mineral constituents." The subject is to be further studied.

A new process for separating butter from cream, B. Grosch (*French Patent No. 258234; abs. in Ind. Agr. Prog., 5 (1897), No. 112, p. 322*).—Fresh cream is submitted to a natural lactic fermentation

sufficient to give the fat globules an albuminous coating, after which it is heated, aërated without agitation, *i. e.*, without churning, and submitted to alcoholic fermentation. The fermentation changes the character of the cream and entirely destroys its viscosity. The fat globules rise to the surface and the other solids remain at the bottom. No churning is required. The fat layer is separated and washed with water to remove adhering particles of casein.

The centrifugal separation of casein and insoluble phosphates from milk, S. M. Babcock (*Wisconsin Sta. Rpt. 1895, pp. 93–99*).—The author mentions the difficulty of separating casein from the other constituents of milk for the purpose of study, and refers to the variety of theories that have been held in regard to its properties and the form in which it exists in the milk.

"Formerly supposed to be in perfect solution, and afterwards to have soluble and insoluble modifications, both of which occur in normal milk, it is now generally believed to be in large part and possibly wholly insoluble and suspended in a very finely divided condition, which gives it a gelatinous or colloidal character."

The author attempted to separate the casein from skim milk by means of a centrifugal separator and thus obtain it in its natural condition. Two experiments were made with an old-style Danish Weston separator "arranged for the experiment by drilling a number of holes through the skimming plate so that portions of the liquid nearest the center of the bowl could be removed from time to time with the skimming tube without disturbing the portion near the walls." The separator was run at the rate of about 4,000 revolutions per minute. In the first experiment the machine was stopped at the end of 3 hours when the sides of the bowl were found to be covered with a rather firm jelly-like deposit about ⅛ in. thick, which was carefully removed.

"This deposit was white with a peculiar fluoresence, being yellowish green by transmitted light and having a bluish tinge by reflected light. When shaken with water it was easily diffused, forming a homogeneous white liquid resembling milk, and no apparent separation took place when the liquid was allowed to stand quietly for a considerable time."

Various reactions showed the deposit to consist in part at least of casein. It contained 29.67 per cent of solids, 22.10 per cent of protein, and 2.98 per cent of ash. The ash was found to consist chiefly of phosphoric acid and lime, the results of 2 separate trials with different milks showing 44.62 and 45.82 per cent of phosphoric acid and 43.72 and 45.30 per cent of calcium oxid, respectively.

"This is approximately the same relation between lime and phosphoric acid found in tricalcium phosphate and there is little doubt that the insoluble ash of milk consists of this salt mixed with a little phosphate of magnesia."

To determine whether this ash was an integral part of the casein or existed independently of it in the milk, skim milk diluted with water, and pasteurized to prevent its souring, was treated in the separator for 3 hours; it was then pasteurized again, kept in a refrigerator until

the following day, and again whirled, and this operation was repeated for the third time.

Partial analyses were made of the milk and the several products obtained in the experiment, the results of which are given. The deposit upon the bowl was very much larger the first day than upon subsequent days, but the proportion of ash in the deposit increased in the second and third whirlings. From this the author believes it is evident that the ash is not chemically combined with the casein, for in that case the proportion of ash would have been the same in all cases. It is also evident that the casein is more easily separated from the milk than the insoluble phosphates of the ash.

"The analyses made in these trials indicate that the deposit upon the bowl consists essentially of casein and insoluble phosphates, its other constituents being easily accounted for by the soluble matter held mechanically in it. The sugar, albumen, and a large portion of the ash are evidently in solution, as their amount in the milk is not diminished by whirling."

To study the question whether the solubility of the nitrogenous constituents of milk is changed by heat in pasteurizing, a quantity of skim milk was divided, one portion being pasteurized and then whirled for 4 hours, and the other being whirled immediately. Analyses showed that the solids-not-fat and the nitrogen were practically the same in the milk before and after whirling, indicating that "neither the casein nor the albumen have been changed in solubility by pasteurizing."

"The fact that pasteurized milk is not as readily coagulated by rennet is satisfactorily explained by assuming that a portion of the lime salts have been removed from solution by heat. This explanation is plausible, for the addition of a little calcium chlorid, acid phosphate or other soluble salt of lime restores pasteurized milk to its normal condition so far as its behavior with rennet is concerned. It is also restored by passing carbonic-acid gas into the milk or by the addition of any dilute acid which dissolves phosphate of lime. For these reasons the writer is of the opinion that the insoluble lime salts of milk are to some extent increased by heat and that the larger amount of ash found in the residue from pasteurized milk in the last experiment is due to this rather than to development of lactic acid in the fresh milk."

The relation between milk solids and the yield of cheese, S. M. BABCOCK (*Wisconsin Sta. Rpt. 1895, pp. 100–119*).—The insoluble constituents of milk, *i. e.*, fat, casein, and insoluble phosphates of lime and magnesia, the author terms the cheese-producing solids. Since the "proximate separation of these solids from milk by the coagulation of casein may be regarded as the essential feature in the manufacture of cheese," the cheese-producing capacity of a milk may be measured by the amount of insoluble matter which the milk contains. The determination of these insoluble solids is believed to furnish an accurate and convenient basis for calculating the relative yield of cheese from milk supplied by different patrons of a cheese factory. To facilitate this, the author presents formulas which he has worked out. The necessary data are obtained by determining the percentage of total solids in milk and in the whey obtained from it in a definite manner. Omitting the details

by which these formulas have been worked out, the following are given, in which

T = percentage of total solids in milk,
t = percentage of total solids in whey,
c = percentage of cheese solids,
F = percentage of fat in milk,
f = percentage of fat in whey,
m = percentage of water in whey.

"(1) Percentage of cheese solids $= \frac{100\,(T-t)}{100-t}$.

"(2) Percentage of casein in milk $= c - F - 0.73 + (100-c)\,0.0068$.

"(3) Yield of cheese $= c + \frac{37c}{m-37}$.

"As the water in whey is quite uniform under all conditions, where normal milk is used, the average percentage, or 93, may be substituted for m, in which case the above expression reduces to

"(4) Yield of green cheese containing 37 per cent of water from 100 lbs. of milk $= 1.66\ c = \frac{166\,(T-t)}{100-t}$.

"In this last expression 100—t represents the percentage of water in whey and may as before be replaced by 93, in which case it reduces to

"(5) Yield of cheese containing 37 per cent of water $= 1.79\ (T-t)$.
T and t representing the percentage of solids in milk and whey respectively. In case the percentage of water in whey differs more than 0.5 from 93, which it rarely does, the more complete formula should be used. . . .

"(6) Yield of green cheese from 100 lbs. of milk $= 1.58\left(\frac{T-F}{3} + 0.91\,F\right)$ in which T = percentage of total solids in milk and F = percentage of fat.

"This formula, although not as accurate as that derived from the solids of the milk and whey, will be found to give very satisfactory results, and when it is considered that the condition of manufacture may cause a variation of several per cent in the amount of water retained in a cheese, it is not unlikely that the yields calculated in this way will conform as nearly to the actual yields as will those calculated from more complete data."

Calculations were made of the cheese-producing capacity as determined by formulas 4 and 6 of the milk delivered by each of the patrons of the university creamery early in July, late in August, and again in October. The results are tabulated. Nearly all the samples of milk examined in July and August were abnormally low in the percentage of solids-not-fat, which the author attributes chiefly to insufficient nutrition, as the season was marked by a prolonged drought, beginning in May, making the pastures extremely short and the grass very dry. Those patrons known to have fed considerable grain through the summer supplied milk containing about the average percentage of solids-not-fat. This is brought out in a table. The fat does not appear to have been diminished by the insufficient food, but was fully up to the average. Sections suffering through the drought reported an unusually low yield of cheese from 100 lbs. of milk, whereas the yield of butter from the same quantity of milk has been about the average, so that owing to the falling off in milk yield the yield of butter per cow was greatly reduced.

With reference to the relation between the fat content of the milk and the yield of cheese, the following table is given:

Relation between fat content of milk and yield of cheese.

Range in percentage of fat.	Patrons' milk.			From students' reports.		
	Average fat content.	Average yield of cheese per 100 lbs. of milk.	Yield of cheese for 1 lb. of fat.	Average fat content.	Average yield of cheese per 100 lbs. of milk.	Yield of cheese for 1 lb. of fat.
	Per cent.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
Under 3.25	....	....	....	3.13	9.19	2.94
3.25 to 3.50	3.31	8.70	2.63	3.38	9.23	2.73
3.50 to 3.75	3.64	9.58	2.63	3.60	9.41	2.61
3.75 to 4.00	3.83	9.83	2.56	3.84	9.81	2.61
4.00 to 4.25	4.15	10.54	2.54	4.09	10.30	2.51
4.25 to 4.50	4.40	11.07	2.51	4.45	10.71	2.41
4.50 to 4.75	4.59	11.20	2.44	....	....	....
Over 4.75	4.93	12.05	2.44	....	....	....
Average	4.20	10.60	2.52	3.64	9.57	2.63

"The yields reported by students are for cured cheese and should be increased by about 4 per cent to corrrespond with those from the patrons' milk, which are for green cheese. Increased in this way, the average yield in factories for 1 lb. of fat is 2.74 lbs. of green cheese against 2.52 lbs., showing clearly that during this part of the summer the cheese-producing solids other than fat have been abnormally low in these milks."

The different methods for paying for milk at cheese factories are commented upon, the relative-value plan being approved, and tables are given showing the yield of cheese and the relative value for cheese-making of milk corresponding to lactometer readings from 26 to 36 and with a fat content from 2 to 6 per cent. The object of these tables is to facilitate calculating the amount to be paid each patron.

Experiments in cheese making, H. L. RUSSELL, J. W. DECKER, and S. M. BABCOCK (*Wisconsin Sta. Rpt. 1895, pp. 127–138, figs. 2*).—*The effect of aëration on the flavor of tainted curds in cheese making, H. L. Russell* (pp. 127–129).—In 2 experiments skim milk directly from the separator was infected artificially with a pure culture of a gas-producing bacillus which had been isolated from the general milk supply of the dairy school. This infected milk was divided into 2 lots, one of which was run through a Danish Weston separator 5 times and the other held at as near the same temperature as possible. Pasteurized cream was then added to both lots to make the milk about normal and the milk made into cheese. In neither case was there any appreciable difference in regard to pin holes between the curds from aërated and non-aërated milk, but in both cases the curd from the aërated milk had a finer flavor than that from the other.

"It has been assumed that the improvement in flavor due to aëration was brought about through some effect on the bacterial life in the milk, but such an interpretation does not seem to be in full harmony with the above results."

The influence of acid on the texture of cheese, H. L. Russell and J. W. Decker (pp. 129–133).—"Experiments were carried out by making cheese

from the same lot of milk in two different ways. In the one instance, the milk was set without developing any acid; in the other, it was ripened according to the usual methods that are now considered essential in Cheddar making."

Duplicate experiments were made with (1) skim milk, (2) skim milk to which sufficient pasteurized cream had been added to give 3 per cent of fat, and (3) whole milk. Figures are given showing the texture of the cheese made under different conditions, and the "mechanical holes."

"The results in every instance were the same and showed that the texture of the cheese fresh from the press was invariably more porous in those made up 'sweet' than where the usual amount of acid was allowed to develop. The development of the acid resulted in a cementing of the particles of curd so that the cheese had a close, uniform texture that is regarded as necessary in a first-class product.

"In the cheese made from milk where the acid was not developed in the curd, the surface was invariably filled with irregular spaces where the curd particles had not closed together. These irregular spaces that may be called 'mechanical holes' are in no way to be attributed to the development of gas, although this is often a common interpretation of their appearance."

The hot-iron test, S. M. Babcock (pp. 133, 134).—This test, used to determine the condition of the curd, is briefly described, and the conditions upon which it depends are discussed. From numerous trials the author has demonstrated that there is no definite relation between the acidity of the curd and the hot-iron test, "although it may be said that long strings are usually associated with high acidity." The addition of a little borax, phosphate of soda, or bicarbonate of soda, all of which have an alkaline action, to sweet curds which do not adhere to the hot iron will make them string as perfectly as if acid was developed, and curds precipitated by the natural development of lactic acid do not always string.

"It appears from this that the hot-iron test indicates not the degree of acidity, but a condition of the curd, which may be brought about in a variety of ways. Our observations show that any reagent, whether acid or alkaline, which has a slight solvent action upon casein, will cause curd to string upon a hot iron. The effect of such a reagent is to convert the curd into a more or less plastic condition in which the particles adhere readily to each other. Such curds when piled will flatten and assume the meaty texture desired in the Cheddar process, before they are put to press. The cheese will also close up well and show few mechanical holes. . . .

"It is evident from this that the determination of acid can never replace the hot-iron test in practical cheese making, as it often fails to show that condition of curd essential to a fine-textured cheese."

Albumen cheese, S. M. Babcock (pp. 134–136).—Experiments were made in incorporating into the cheese the albumen which is usually lost in the whey, not being acted upon by rennet. The albumen was separated by passing the heated whey through an old-style Danish Weston separator. The albumen was then collected, mixed with water, and the following day incorporated with the curd, when the rennet was added. The usual methods of making Cheddar cheese were followed.

"Curds made in this way are more tender than where nothing has been added to the milk; they 'firm up' nicely, however, and have a good flavor, scarcely distinguishable from curds made without the albumen. The cheeses do not close up as well as ordinary curds. The yield of green cheese in our experiments has been increased a little more than 17 per cent by adding the albumen. These cheeses have retained their shape and for a week or two have appeared like other cheese, but have soon acquired a sour, disagreeable taste, and a granular texture similar to cottage cheese. A number of experiments have all resulted in this way, there being not a single cheese of good quality in the whole lot."

The experiments are being continued.

Experiments in ripening the milk before setting, J. W. Decker (pp. 136–138.)—Experiments were made to compare the effect on the time required for cheese making of adding the rennet as soon as the sweet milk had been heated to the proper temperature, and of first allowing the milk to ripen before setting. Data are given showing for different trials the rennet test, development of lactic acid, and time required for different operations. There was no difference in the time required for making the milk into cheese between developing the acid in the milk before setting or between setting the milk and drawing the whey.

Other experiments were made to see if the acid would develop as rapidly in the curd if the whey was drawn before it would string on the hot iron.

"As far as the time required to make the milk into cheese is concerned (liability of whey-soaked curds not considered) it makes no difference whether we develop the acid in the milk or in the whey, but it does require more time if we draw the whey before the strings appear in the hot-iron test."

Gas-producing bacteria and the relation of the same to cheese, H. L. RUSSELL (*Wisconsin Sta. Rpt. 1895, pp. 139–150, figs. 2*).—The causal relation of germs to the production of "pin hole" cheese was shown in a trial in which milk was treated different ways; pin holes were numerous, except where the milk was pasteurized or formalin added. Cultures of gas-producing bacteria inoculated into sterile milk gave a vigorous gaseous fermentation. From a single sample of mixed milk taken at the university creamery one day in July 6 different species were isolated that had the ability of producing gas, although they differed in respect to this gas-producing power. Their addition to fresh milk almost always resulted in the production of a pronounced taint.

A large number of experiments were made with the different gas-producing organisms isolated to study their effect upon the texture and quality of the cheese, and the results obtained with a single form are presented. Separator skim milk, separator skim milk to which pasteurized cream had been added, and whole milk were used. In one series of experiments the cheese was made up comparatively sweet, while in the other the normal amount of acid was allowed to develop.

"The result was uniformly the same, although it differed in degree, owing to the impossibility of adding the same amount of culture starter in each instance. In some of the experiments the gas appeared in the curd while the acid was developing on the racks; in others its appearance was delayed until the cheese was on the shelf. In one case the development of gas in the infected cheese was so great that

the cheese huffed into a football shape and rolled off the shelves. The tension of the gas was so great in this instance that it forced its way through the exterior coating with a hissing sound. In all cases the cheese made from infected milk, whether it was handled according to the sweet or acid process, invariably showed a larger number of holes than the control. . . . The effect of the development of the acid on the production of gas holes is strongly marked. This could have been materially increased if the acid had been allowed to develop still further and the curd had been piled on the rack during matting to mechanically force out the gas, as would have been done in a practical way."

The general characteristics of the gas-producing bacteria are described and some experiments given in testing their distribution in the milk of the different patrons of the university creamery. This was done by means of fermentation tests in which pint milk bottles were sterilized and then filled nearly to the top with milk from different patrons, a definite amount of rennet extract being added to each bottle, and the bottles immersed in water at 86° F. "The normal conditions practiced in cheese making were adhered to quite closely in these tests, so that practically the various stages of making Cheddar cheese up to the point of putting to press were carried out."

These tests showed that (1) the gas-producing organisms were widely distributed throughout the section tributary to the university creamery; (2) a larger number of patrons have "gassy" milk in the winter than in summer; (3) in the majority of cases there was a uniformity as to the presence or absence of these organisms in the milk, "so that the employment of the fermentation test as an index to the value of the milk for cheese making is to be highly indorsed;" (4) there is often a radical difference in the texture of the curd from different milk as shown by this test, which can not be explained; and (5) this method also reveals the presence of bacterial taints other than those caused by the gas-producing germs.

"The conditions under which the milk is secured in the winter as a rule favor the introduction of a larger number of bacteria than is the case during the summer. Dirt and particles of excreta on the coat of the animal are apt to accumulate during the period that she is housed, and as these are easily dislodged, they fall into the milking pail, contaminating the fluid.

"The main reason why the gaseous fermentations do not manifest themselves more during the winter is because the temperature conditions do not favor the rapid increase of bacterial life at this time. Where milk is held for a sufficient length of time to allow full germination of these organisms, it is apt to develop pin holes in the curd, as was found in our experience at the dairy school, when the milk was shipped by rail for a short distance and was often somewhat overripe upon arrival."

A Jersey ten years' record, A. F. PARBURY (*Agl. Gaz.* [*London*], *44* (*1896*), *Dec. 28, p. 575*).

Cow culture, F. D. COBURN (*Rpt. Kansas State Bd. Agr. for the quarter ending Sept. 30, 1896, pp. 261, figs. 35*).—This report is "devoted to the promotion of dairy interests, a better appreciation of the importance, products, and possibilities of the cow, and counsel as to her selection, breeding, and management." It contains an introductory article on dairying, its essential conditions and conduct, and adaptability to Kansas; and a compilation of a wide range of material bearing upon dairying and dairy farming, the selection, care, and feeding of cows, building up the dairy herd, raising calves, keeping milk records, testing herds, examples of notable

dairy stock, silos and silage, the organization and management of coöperative creameries, construction of creamery buildings, cream raising, butter making, cheese making, relative profits of butter and cheese making, etc. The report is popular in style and contains a vast amount of useful information, gathered from the experience of successful farmers and dairymen and from the work of the agricultural experiment stations.

The composition of camels' milk, DINKLER (*Pharm. Ztg., 1896, No. 41; Ztschr. Fleisch und Milch Hyg., 7 (1897), No 5, p. 98*).

Loss in dry matter of milk by souring, H. HÖFT (*Chem. Ztg., 21 (1897), No. 4, p. 24*).—A table shows notable losses in dry matter in souring, amounting to several tenths of a per cent by the time the milk curdled thickly.

Some sanitary aspects of milk supplies and dairying, S. BURRAGE (*Purdue University Monographs, No. 2, pp. 20*).—A compiled popular bulletin, treating of milk in general, the bacteria of milk, sources of contamination and infection, and milk in its relation to public health.

Power tests of centrifugal cream separators, A. W. RICHTER (*Wisconsin Sta. Rpt. 1895, pp. 151–157*).—This is a shorter account of work reported in Bulletin 46 of the station (E. S. R., 8, p. 170).

Milking by machinery (*Amer. Agr. (mid. ed.), 59 (1897), No. 8, p. 227, figs. 2*).—Descriptions are given of the Cushman, De Laval, and Thistle milking machines, with illustrations of the first two.

The use of bacterial culture starters in butter making, with especial reference to the Conn culture (B. 41), E. H. FARRINGTON and H. L. RUSSELL (*Wisconsin Sta. Rpt. 1895, pp. 174–226, charts 12*).—A more detailed account of work reported in Bulletin 48 of the station (E. S. R., 8, p. 261).

Dairying, J. MAHON (*Queensland Dept. Agr. Bul. 9, 2d ser., pp. 39*).—This is a popular bulletin on the subject of dairying, covering the various phases of butter making, cheese making, handling of milk and cream, dairy buildings, management of cows, etc.

AGRICULTURAL ENGINEERING.

An experiment in draining low-lying marsh lands by means of a dike, a sump or reservoir, tile drains, and a windmill, W. A. HENRY (*Wisconsin Sta. Rpt. 1895, pp. 232–236, pl. 1, fig. 1*).—The successful reclamation of 20 acres of marsh land typical of "thousands of acres of wet lands in southern Wisconsin" is described. The method of reclamation was briefly as follows: A dike 4 ft. wide on top and rising 18 in. above water level was built across the lower end of the area. Inside of this, and about 10 ft. from it, a ditch was dug which emptied into a reservoir (40 by 60 ft. in area and 4 ft. deep). Near this reservoir and connected with it by means of a 6-inch sewer pipe was a bricked-up well. "Over the well was placed a 14-foot Eclipse windmill, carried by a 40-foot tower. The pump rod of the windmill was attached to an 8 by-12-inch common iron pump placed low down in the well. The windmill operates the pump and lifts the water of the well flowing in from the sump, throwing it over the dike into the creek by means of a 6-inch iron discharge pipe." To prevent the water from freezing during winter the reservoir was covered with boards and marsh hay, and manure was packed around the pump.

The draining was done during the fall of 1894, and in the fall of 1895 there was harvested "one of the largest crops of fodder ever grown on the farm, the stalks carrying a fair amount of ears."

The water was brought to the ditch by means of parallel lines of tile laid 33 ft. apart, many of which tapped springs.

Experiments in irrigation, F. H. KING (*Wisconsin Sta. Rpt. 1895, pp. 237–252, figs. 8.*)—These experiments are essentially a repetition of those recorded in the Annual Report of the station for 1894 (E. S. R., 8, p. 295). They "had for their primary object the ascertaining of the possible increase of yield over that which may result from the natural rainfall of the season and locality."

Surface and subirrigation of corn.—

"The comparison was made upon 2 areas, one of which covered a little more than 1 acre of ground, while the other was only one-fourth as large. . . .

"The larger of the 2 experimental areas (D) was divided into 5 equal plats, each of which bore upon one half dent and on the other half flint corn. The center plat of the 5 was subirrigated, the adjacent ones on either side were surface irrigated, while the remaining 2 plats, one adjacent to each of the surface-irrigated plats, were allowed to develop under the conditions of natural rainfall.

"In the subirrigated plat the water was distributed through 3-inch drain tile, placed 18 in. below the surface in parallel rows 10 ft. apart, but connected by a continuous line of tile extending past one end of each row. . . .

"On the smaller plat (C) subirrigated corn was compared with that not irrigated, the tile being 18 in. below the surface and only 5 ft. apart. Flint corn was grown upon this plat."

The yields of dry matter in the corn on the different plats during 1894 and 1895 are shown in the following table:

Yields of dry matter in corn on unirrigated, subirrigated, and surface-irrigated plats.

	Amount of rainfall.	Amount of water pumped.		Yield of dry matter.			
				Field C.		Field D.	
		Field C.	Field D.	Dent corn.	Flint corn.	Dent corn.	Flint corn.
RESULTS IN 1894.	*Inches.*	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Not irrigated	8.15	....	....	4,679	....	7,426	7,916
Surface irrigated	8.15	....	8.61	....	....	9,625	11,080
Subirrigated	8.15	19.07	13.72	8,614	....	7,907	9,545
RESULTS IN 1895.							
Not irrigated	4.48	....	....	....	2,701	3,144	2,458
Surface irrigated	4.48	....	26.60	....	....	11,125	10,048
Subirrigated	4.48	37.88	26.60	....	8,202	8,347	6,295

"It will be seen that in all cases the yield from the irrigated land was much larger than from that not irrigated, and that the surface-irrigated lands yielded both years much better than the subirrigated lands did. . . . In 1894 the surface-irrigated corn gave a yield more than a third larger than that not irrigated, while in 1895 the yield from the surface-irrigated ground was nearly 4 times that from the land not irrigated."

The table shows that on the unirrigated soil the smaller the rainfall the less the yield of corn, and that this was not due to the exhaustion of the soil by the continuous growth of corn on the same land without manuring is indicated by the fact that where surface irrigation was

practiced the yield was 234 lbs. greater in 1895, the year of scanty rainfall, than in 1894. On the other hand, the subirrigated soil yielded 1,074 lbs. less in 1895 than in 1894, a result which is explained by the fact that in this case the surface soil did not obtain sufficient moisture to give the maximum growth of corn.

The data reported show "that the yield of dry matter per acre was more than one-fifth, or 23.36 per cent, larger on ground surface irrigated than it was on that subirrigated. This difference of yield, in the writer's judgment, is due to the fact that a large part of the water introduced into the subirrigated land percolated below the level of most effective service in the root zone, while at the same time a large part of the surface soil, where the vital processes are most active, was left too dry."

It was observed that when 15.03 acre-inches of water was pumped into the tiles only about 4 ft. of the surface soil immediately above the lines of tile was saturated, while midway between the tiles the soil was wet only to within 9 in. of the top. It is estimated that at least 5 acre-inches more of water would have been necessary to completely saturate the soil of the whole plat. It is evident, therefore, that by applying equal amounts of water by the surface and subirrigation methods at stated intervals the amount of moisture in the surface foot of soil will average much larger in the former than in the latter case.

"It follows from these observations that instead of requiring less water for subirrigation than for surface irrigation, as has been generally assumed, it does require much more when applied at a depth of 18 in. on lands where the ground water is 6 or more feet below the surface irrigated."

It is possible that a greater economy of water would have been realized if the tile had been placed nearer the surface of the soil.

Irrigating through systems of tile drains.—As in the experiments of the previous year (E. S. R., 8, p. 295), the outlet of the system of tile drains was closed and water pumped into them in order to determine the effect of raising the water level on the yields of clover, barley, and corn.

On May 24 and 25, 2.84 acre-inches of water was pumped into the system. The irrigation was repeated June 24, 25; July 10, 11, 12, 22, 23, 24, and August 8, 9, 10, 21, 22, and 23, aggregating in all about 17.04 acre-inches. Besides this, the clover plat was surface irrigated June 17, July 12, and August 19.

Two crops of clover were cut on the irrigated area (3.2 acres), the first yielding at the rate of about 4 tons per acre, the second about 1.8 tons. The third crop (on the 3.2 acres) furnished pasturage for 58 sheep for 31 days.

The unirrigated soil yielded a single crop of about 1.5 tons per acre. The increase due to irrigation on the total area was 5.5 tons of hay, which, with the pasturage, is valued at $39. The cost of production of this increase is estimated at $18, leaving a net profit of $21.

The barley yielded at the rate of 3 tons per acre (grain and straw). No comparative data for yield on unirrigated soils were obtained.

The same was true of the experiments on corn, of which the yields on the irrigated soil were as follows: Dent corn, 7,138 lbs. of dry matter per acre; flint corn, 6,139 lbs. It is assumed that the yield of corn was more than doubled in 1895 by the application of water.

The effectiveness of natural subirrigation is illustrated by observations during 1895 on the growth of corn on a reclaimed marsh. The black marsh soil is underlaid with a thin stratum of clay, which rests upon porous sand, "through which the water from the adjacent high hills flows toward the lake and slowly rises by upward percolation." That the water rose in this manner was shown by the continuous discharge of the drains, and that the corn utilized this water was indicated by the fact "that immediately after cutting the corn and without any rain the drains began to discharge water much more rapidly."

STATISTICS.

Reports of director and of treasurer of California Station, 1895 (*California Sta. Rpt. 1895, pp. XIII, 1-10, 459-468*).—List of officers of the station and substations; brief notes upon work of the year by the director; lists of plants, trees, and seeds donated to the station, and of papers received; and a financial statement for the fiscal year ending June 30, 1895.

Report of the Southern California Culture Station, C. H. SHINN (*California Sta. Rpt. 1895, pp. 422-438*).—A report is given of the general work undertaken at this station, which is located in the Chino Valley between Pomona and Chino, with meteorological tables showing rainfall and temperature. Detailed reports are given showing the condition of the orchards, and notes on various varieties of apples, cherries, figs, nectarines, peaches, pears, plums, oranges, olives, date palms, strawberries, blackberries, etc.

A report is also given on a 10-acre tract at this station opening up new lines of investigation, experiments having been conducted with various grasses and cereals, together with an attempt to test the fitness of this particular tract of land for orchards and growing sugar beets.

Report of the Southern Coast Range Culture Station, C. H. SHINN (*California Sta. Rpt. 1895, pp. 371-400*).—A report is given on the cultural work at the station, with climatic records giving the dates of spring frosts since 1889, notes on various improvements that have taken place at the station, and detailed accounts of different varieties of almonds, apples, apricots, cherries, figs, peaches and nectarines, pears, plums and prunes, olives, quinces, English walnuts, pecans, Italian chestnuts, strawberries, and Logan berries. Brief notes are also given on the cereal and hay crops, and a report on the condition of the vegetable garden, including notes on varieties of lettuce, tomatoes, radishes, garden beets, carrots, parsnips, turnips, peas, beans, kale, onions, cauliflower, potatoes, muskmelon, watermelons, and tobacco. A brief statement is given on the damage done at the station by squirrels, gophers, and birds.

The work of the college of agriculture and experiment stations, E. W. HILGARD (*California Sta. Bul. 111, pp. 17*).—An article revised from lectures delivered at farmers' institutes which treats in a popular way of the work of instruction and research of the College of Agriculture and Experiment Stations of the University of California.

Ninth Annual Report of Illinois Station, 1896 (*Illinois Sta. Rpt. 1896, pp. 16*).—This report includes a general account of the transactions of the governing board, a list of the bulletins issued during the year, a tabulated statement showing date of beginning of each experiment in progress and bulletins in which reported, and a detailed financial statement for the fiscal year ending June 30, 1896.

Seventh Annual Report of Nevada Station, 1894 (*Nevada Sta. Rpt. 1894, pp. 28*).—This includes outlines of station work by the director and heads of the departments of agriculture and horticulture, botany and entomology, and chemistry and dairying; and a financial report for the fiscal year ending June 30, 1894.

Reports of director and treasurer of Wisconsin Station, 1895 (*Wisconsin Sta. Rpt. 1895, pp. VIII, 1–6, 332–343*).—Account by the director of condition and work of the station; lists of publications of the station available for distribution, of periodicals received as exchanges, and of donations made to the station; text of the State fertilizer law; and a financial statement for the fiscal year ending June 30, 1895.

Report of the experiment station of the Brunswick Agricultural Society, 1896 (*Braunschw. landw. Ztg., 65 (1897), No. 4, pp. 13, 14*).—Classification of analytical and testing work of the station.

Report of work in 1895 at the agronomic station of the Island of Mauritius, P. BONAME (*Ann. Sci. Agron., ser. 2 (1896), II, No. 3, pp. 321, 322*).

NOTES.

CALIFORNIA UNIVERSITY AND STATION.—F. T. Bioletti has been made instructor in bacteriology and wine making.

The station has recently imported from France 30,000 phylloxera-resistant grape cuttings of rupestris and riparia stock, for distribution among the vine growers of California.

FLORIDA STATION.—The station has recently completed a small glass house for propagating plants, and for the study of plant diseases and insect pests.

KENTUCKY STATION.—Dr. R. J. Spurr, superintendent of field experiments of the station, died March 8.

MISSOURI STATION.—Mr. David W. May, M. Agr., has been appointed to succeed Mr. C. M. Connor as assistant in agriculture in the station.

SOUTH CAROLINA COLLEGE AND STATION.—Mr. C. M. Connor, B. Agr., B. S., late assistant in agriculture at the Missouri Agricultural Experiment Station, has accepted the position of assistant professor of agriculture in the college and agriculturist of the station, taking effect February 15, 1897.

UTAH STATION.—Prof. F. C. Sears, M. S., of the Kansas Agricultural College, has been appointed horticulturist and botanist of the station and college, and has entered upon his duties.

WASHINGTON STATION.—Mr. W. H. Heileman has been elected assistant chemist, *vice* C. C. Fletcher, resigned.

The third annual session of the winter school for farmers was attended by 169 farmers. The interest was greater than at any previous session.

GERMAN AGRICULTURAL SOCIETY.—The eleventh general exhibition of this society will be held at Hamburg June 17 to 21, 1897. These fairs are held annually, a different place being selected each year. The exhibitions of stock, agricultural products, and implements and farm supplies of various kinds are very large, and the fairs attract large numbers of agriculturists and farmers from all over the German Empire. The cash prizes offered this year aggregate about $25,000, besides which there are a large number of medals, diplomas, etc. This society is nonpolitical, and is maintained without federal aid. It numbers over 11,000 members at present. It has headquarters in Berlin, where it occupies an entire building with its offices and laboratories. It publishes a journal and a yearbook, both of which are valuable publications. It does much to encourage investigation in various lines of agricultural science. Through the society members can purchase fertilizers, feeding stuffs, and seeds at reduced rates, and with the advantage of securing goods of guarantied composition and purity. The transactions in these supplies are now enormous, and this coöperative buying has been extended to agricultural machinery and other supplies. The society is a noteworthy instance of a successful coöperative scheme in the farmers' interests.

PERSONAL MENTION.—L. H. Bailey, professor of horticulture at Cornell University, has been awarded one of the Veitch silver medals "in recognition of his efforts by means of his lectures and writings to place the cultivation of plants on a scientific basis, to promote the extension of horticultural education, and by numerous trials and experiments to improve and render more productive plants grown for economic purposes."

M. Georges Ville, one of the most prominent of the agricultural scientists and authors of France, died February 22, 1897, at the age of 73 years. At the time of his death he was connected with the Museum d'Histoire Naturelle. A sketch of his life and works by L. Grandeau appears in *Journal d'Agriculture Pratique, 61 (1897), I, No. 9, pp. 307–309.*

Dr. Eugene Baumann, the well-known physiological chemist, died in Freiburg, Baden, November 5, 1896. A portrait and review of his life is given in *Ztschr. physiol. Chem., 23, No. 1, pp. 1–17.* Dr. Baumann was born December 12, 1846. At the time of his death he was professor of chemistry in the medical department of the University of Freiburg. Shortly after the revival of the University of Strassburg he was Hoppe-Seyler's first assistant. He was called to Berlin as the head of the chemical department of the Physiological Institute, and later was made a full professor. After a number of years in Berlin he was called to Freiburg, where he remained until the time of his death. After Hoppe-Seyler's death his position was offered to Dr. Baumann but was not accepted. Dr. Baumann contributed largely to the progress of organic and physiological chemistry.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vols. I to VII, with indexes; Vol. VIII, Nos. 1–7.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, the Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of Stations and Colleges, 1892; No. 13, Organization Lists of Stations and Colleges, 1893; No. 14, Proceedings of Convention of National League for Good Roads, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of Stations and Colleges, 1894; No. 20, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of Stations and Colleges, 1895; No. 24, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of Stations and Colleges, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University in 1895; No. 33, The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses; No. 34, The Carbohydrates of Wheat, Maize, Flour, and Bread, and the Action of Enzymic Ferments Upon Starches of Different Origin; No. 35, Food and Nutrition Investigations in New Jersey in 1895 and 1896; No. 36, Notes on Irrigation in Connecticut and New Jersey; No. 37, Dietary Studies at the Maine State College in 1895; No. 38, Dietary Studies with Reference to the Food of the Negro in Alabama in 1895 and 1896; No. 39, Organization Lists of Stations and Colleges, 1897; No. 40, Dietary Studies in New Mexico in 1895.

Miscellaneous Bulletins.—Nos. 1, 2, and 3, Proceedings of Association of Agricultural Colleges and Experiment Stations, January and November, 1889, and November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates; No. 48, The Manuring of Cotton; No. 49, Sheep Feeding.

The Agricultural Experiment Stations of the United States.

R. Kent Beatt

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

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EXPERIMENT STATION RECORD

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1897

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*.

AND

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C. F. LANGWORTHY, PH. D.—Foods and Animal Production.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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EXPERIMENT STATION RECORD.

VOL. VIII. NO. 9.

It is often an encouraging thought when progress in a particular line of investigation seems slow that practically all of our present science of agriculture has been worked out within the lifetime of the present generation. This thought is suggested especially by the death within a few months of two men who have been intimately associated with this work and who have seen it grow almost from first principles. These men—Prof. Emil von Wolff, of Hohenheim, Germany, and Prof. Georges Ville, of Paris—have been widely known for their scientific work and their writings. Especial interest attaches to the former, as he was the organizer and first director of the first experiment station established for the promotion of agriculture.

It was in 1840 that Liebig published his book on Chemistry in its Relation to Agriculture and Physiology, which made so deep an impression in agricultural circles throughout Europe. This soon led to agitation in Germany in regard to appointing at State expense chemists who should devote their services to the interests of agriculture, resulting in the establishment at Möckern in 1851 of the first agricultural experiment station. Emil Wolff, then a young man of 33 years, and a teacher of natural sciences in the agricultural school at Brösa, was chosen the first director of the station, and to him fell the duty of organizing it and of planning its work. After serving for three years at this station he went to the agricultural academy at Hohenheim, where he remained as professor and as director of the experiment station until 1894, when he resigned and retired to private life. At the time of his death, in November last, Professor Wolff was 78 years old.

While both Wolff and Ville contributed materially to the advancement of agricultural science, they will be remembered especially for the deductions which they made from the progress of science and their efforts to bring about the application of these teachings in practice. In this field of popular writing they represented the two great divisions of the work—Ville, the manuring of the soil and the use of commercial fertilizers, and Wolff, the feeding of farm animals especially, although he wrote much on the use of fertilizers.

Emil von Wolff supplied the link between theory and practice. He had constantly in mind the application of new discoveries in agricultural science to farm practice, and he sought by his compilations to

present the progress of agricultural science in such a way as to encourage this. His work was quite largely that of a compiler, and it was so well done that the results were scarcely less useful to the practical farmer than to the investigator. An idea of the extent to which his writings reached the public is furnished by the statement of his publishers that 22,000 copies of his *Düngerlehre* (Principles of Manuring) and 30,000 copies of his *Fütterungslehre* (Principles of Feeding) were sold in the original. Furthermore, over 35,000 copies annually of his tables of fertilizers and feeding stuffs in Mentzel and von Lengerke's Agricultural Calendar "found their way into the breast pockets of practical farmers." Considering the numerous translations of his works and that hardly a popular bulletin on the principles of feeding is issued which is not based to a considerable extent on his writings, it is evident that the influence of his books can not be estimated. They have done much to bring about the practical application of scientific teachings, and they have stimulated investigation in both practical and theoretical lines.

Prof. Georges Ville, like Wolff, possessed in an eminent degree the capacity for popularizing scientific work in agriculture, and, next to Liebig, he perhaps contributed more than any other man to the extension and systematizing of the use of commercial fertilizers. He accomplished this, it is true, largely by dogmatic teaching, much of which has since been proved erroneous, but at the time it appealed strongly to the practical agriculturist, whose constant demand is for scientific rules and fixed formulas applicable under all conditions. He early outlined and advocated a system of plat experiments for the purpose of studying the fertilizer requirements of soils, which is substantially the same as that followed in such work to-day.

Ville was one of the first to maintain, on the basis of elaborate experiments, that certain plants had the power of assimilating the free nitrogen of the air, and his controversy with Boussingault on this point has become classic. But he failed to discover the true explanation of assimilation of free nitrogen by plants, suggesting that it was due to a process of nitrification in the leaves of the plant. Later, when the nitrogen assimilation was explained by the investigations of others, he became an enthusiastic advocate of the practice of green manuring with leguminous plants, accompanied by applications of lime, phosphates, and potash to maintain the fertility of the soil.

At the beginning of the second empire Ville was appointed professor of vegetable physiology in the museum of the Jardin des Plantes of Paris, a position which he held at the time of his death. In connection with this position he had the management of the experimental fields at Vincennes, near Paris, where much of his most important work was done. He died at Paris February 22, 1897, at the age of 74 years.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The determination of nitrogen in mixtures of nitrates, especially in guano, V. SCHENKE (*Chem. Ztg., 20 (1896), No. 104, pp. 1031–1033*).—The combination of the Ulsch and Kjeldahl methods proposed by the author in 1893 [1] is defended against the criticisms of Haselhoff. He reports comparative tests of this method, the Jodlbauer-Förster method, and the Haselhoff method [2] on 6 samples of guano, nitrate of soda, and mixtures of guano and 2 to 5 per cent of nitrogen in the form of nitrate. The Kjeldahl and Ulsch-Kjeldahl methods gave the calculated percentages of nitrogen. The Haselhoff method gave good results, except when large amounts of uric acid and similar compounds were present. In case of the mixtures the Jodlbauer-Förster method gave good results only when the nitric nitrogen did not exceed 2 per cent. On pure nitrate it gave low results. This is ascribed to loss of nitrogen in evaporating the solution to dryness in this method. It is claimed that no such loss occurs in the author's method. In presence of nitrogen oxids and nitrous compounds both the Ulsch-Kjeldahl and Jodlbauer methods are unreliable.

Studies of the different methods for determining cellulose, H. SURINGAR and B. TOLLENS (*Jour. Landw., 44 (1896), No. 4, pp. 343–356, and Ztschr. angew. Chem., 1896, No. 24, pp. 742–750*).—The authors made an extended study of the principal methods which have been proposed for the determination of cellulose, using filter paper, cotton, sawdust, wood cellulose, jute, etc. These methods included the common Weende method, Franz Schulze method (digestion at low temperature with nitric acid and potassium chlorate), Hönig method (digestion at 210° with glycerin and subsequent treatment with hydrochloric acid)[3], Gabriel method (digestion at 180° with a glycerin solution of potash)[4], Lange method (evaporation to dryness at 180° with concentrated potash solution)[5], and the chlorin method of Cross and Bevan [6]

[1] Chem. Ztg., 17 (1893), p. 977 (E. S. R., 5, p. 222).

[2] Landw. Vers. Stat., 43 (1894), p. 289 (E. S. R., 6, p. 609; 8, p. 23).

[3] Chem. Ztg., 14 (1890), pp. 868, 902.

[4] Ztschr. physiol. Chem., 16, p. 370 (E. S. R., 3, p. 910).

[5] Ztschr. physiol. Chem., 14, p. 283.

[6] Cellulose, an outline of the chemistry of the structural elements of plants, p. 95.

(treatment consecutively with 1 per cent soda solution, chlorin gas, sodium sulphite, potassium permanganate or sodium hypochlorite, and sulphurous acid).

The authors' conclusions from these investigations are that none of the methods fulfill all the requirements of a good method for cellulose in point of time and accuracy. The cellulose obtained by these methods usually contained larger or smaller quantities of furfurol yielding substances or oxycellulose, and except in the case of the Schulze method the cellulose itself was attacked by the reagents. The methods of Hönig and Cross and Bevan give cellulose containing considerable lignin, as shown by the phloroglucin-hydrochloric acid reaction.

The potash methods (Gabriel and Lange) give pure cellulose, especially the Lange method, but they attack the cellulose to a considerable degree.

Schulze's method appears to give the most accurate figures for the vegetable substances examined, although the cellulose frequently contains oxycellulose. The time required for this method (14 days) is considered a serious objection to it. A simple and reliable method for cellulose, not requiring too much time, is believed to be a great desideratum.

On the fermentation of galactose, A. BAU (*Ztschr. Spiritusind., 1896, No. 38-39; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 20, pp. 653-655*).

The production of compounds isomorphous with kainit and tachhydrit, A. DE SCHULTEN (*Bul. Soc. Chim. Paris, 17-18 (1897), No. 3, pp. 165-167*).

A simple method for determining zinc in foods (*Ztschr. Nahr. Untersuch. und Hyg. Waarenk., 11 (1897), No. 2, pp. 25, 26*).

A simple method for detecting salicylic acid and boric acid in food and condiments, E. LUDWIG (*Ztschr. Nahr. Untersuch. und Hyg. Waarenk., 10 (1896), No. 23, pp. 377-388*).

Method of transforming the casein of milk into albumose and peptone by means of bacteria, A. BERNSTEIN (*Pharm. Centralhalle, 37 (1896), p. 31*).

Recognition of margarin by admixtures of starch, SOXHLET (*Milch Ztg., 26 (1897), No. 2, pp. 17, 18*).

Apparatus for volumetric determination of fat in milk, A. W. STOKES (*English patent; Milch Ztg., 26 (1897), No. 3, p. 41, fig. 1*).—Milk is treated with amyl alcohol and sulphuric acid in a special tube, and the column of separated fat measured on the graduated stem.

Investigations on the anilin colors in white wines and the distinction between these colors and caramel, A. D'AGUIAR and W. DA SILVA (*Compt. Rend., 124 (1897), No. 8, pp. 408-410*).

Contributions to the analysis of fats: VII. The gravimetric determination of the bromin value, S. J. LEWKOWITSCH (*Jour. Soc. Chem. Ind., 15 (1896), No. 12, p. 859*).—The author has reviewed some recent work on this subject by Hehner (*Analyst, 1895, p. 50*). A number of oils were tested, and with every one except olive and rapeseed oils the Hübl iodin value was widely different from the iodin value calculated from the bromin value determined gravimetrically. The drying of the brominated fats was found to be slow and tedious. The author concludes that the introduction of the gravimetric bromin process is out of the question.—A. M. PETER.

On the experimental methods employed in the examination of the products of starch-hydrolysis by diastase, H. T. BROWNE, G. H. MORRIS, and J. H. MILLAR (*Chem. News, 75 (1897), No. 1939, pp. 42, 43*).

On the separation of laccase and tyrosinase found in certain mushrooms, G. BERTRAND (*Bul. Mus. Hist. Nat. Paris, 1896, No. 7, pp. 358–360*).

White wine vinegar, A. H. ALLEN (*Analyst, 21 (1896), Oct., p. 254*).—This vinegar is made from the wine of the white grape and may be distinguished from distilled malt and diluted acetic acid vinegars from its containing considerable extractive matter and acid potassium tartrate.—B. W. KILGORE.

The standardizing of permanganate of potash, V. E. PAVLOF (*Jour. Soc. Phys. Chim. Russe, 28, pp. 621–647; abs. in Bul. Soc. Chim. Paris, 17–18 (1897), No. 2, pp. 89–94*).

On some new forms of gas generators, T. H. NORTON (*Jour. Amer. Chem. Soc. 18 (1896), No. 12, pp. 1057–1061, figs. 3*).—Three new forms of generator are described, one for hydrogen sulphid, etc., made of glazed earthenware and arranged so that the acid may be rendered of uniform strength; another designed for the same purpose, which may be constructed in any well-equipped laboratory; and a third form, an automatic chlorin generator. The figures are necessary to explain the construction of each.—F. W. MORSE.

Note on the durability of platinum-iridium vessels in laboratory use, T. FAIRLEY (*Jour. Soc. Chem. Ind., 15 (1896), No. 12, p. 886*).—The author exhibited vessels made of alloy of platinum with 10 per cent of iridium, which had been in everyday use more than 14 years. If carefully used the ware does not crack, as has been sometimes objected.—A. M. PETER.

The technique of physiological chemistry and pathology, A. SLOSSE (*Technique de chimie physiologique et pathologique. Brussels: M. Lamertin, 1896, pp. 250, ill.*).—A laboratory manual.

BOTANY.

On the absorption and rejection of water by seed, H. COUPIN (*Ann. sci. nat. Bot., ser. 8, 2 (1895), No. 1–3, pp. 129–222, figs. 34*).—An extended study has been made on the absorption of water by various kinds of seed during their swelling preliminary to germination and its rejection during maturation. The work is divided into three parts, in which were studied (1) the ordinary swelling of seed and their absorptive power, (2) the increase in volume as compared with the amount of water penetrating their integuments, and (3) the rejection of water during maturation. In the first 2 categories only the physical phenomena were studied, no attention being given the physiological and chemical phenomena accompanying their swelling.

The subjects for experimentation were seed of lupines, beans, peas, wheat, maize, castor beans, hemp, barley, buckwheat, sunflower, etc.

The author gives a summary of his work, in which the following are the most important conclusions:

Seeds are readily divided into 2 classes, dependent upon whether their seed coats become wrinkled or not.

When placed in water seeds do not swell equally in all dimensions, and the power of absorbing water varies greatly for the same variety. In some cases there is a quantity of free water present varying from one-thirtieth to one-eighth of the total amount absorbed. This amount is greatest at the time of saturation and is considerably increased by the use of anæsthetics. An increase of pressure increases the absorbing power, while changes of temperature do not affect it. An injury to the

integument increases the rapidity but not the total absorptive capacity. Seeds nearly covered with water will become saturated, while if only a small portion of the surface is exposed to water the amount absorbed will be small, in some cases not sufficient to induce germination.

The ability of seed to absorb watery vapor was studied, and it is stated that they have considerable power in this respect, but the entirety of the integument greatly reduces this absorption. The ability to absorb vapor differs with individuals, and the vitality of the seed is influenced by such absorption.

The splitting of the integument is not produced by the swelling of the embryo, nor is the radicle by simple pressure able to pierce the walls of the seed coat. It is thought that some diastase is present to aid in this process.

Under the second head it was found that with some seed imbibition of water produced a swelling, while in other cases there was a contraction in volume. There is an expansion followed by a contraction with seed having a thin integument which is capable of wrinkling. The dilation is caused by the separation of the integument from the seed, the rapid imbibition of water creating a space which is filled by gas. Contraction in volume takes place during the imbibition by seeds having hard seed coats, akenes, and injured seed. It is caused by chemical combinations formed by the water and the reserve material of the seed.

In the process of ripening the drying of the seed is due to a regular transpiration, and not simple evaporation.

The action of salts on the form and structure of plants, C. DASSONVILLE (*Rev. gén. Bot., 8 (1896), Nos. 91, pp. 284–294, pls. 2, figs. 2; 92, pp. 324–336, pls. 2, figs. 2*).—The author has studied the effect of various salts when supplied to plants growing in water cultures, comparing the development of plants which were supplied with certain salts with the development of plants grown in distilled water and in Knop's culture solution. This solution is prepared after the following formula:

Calcium nitrate	grams..	1.00
Potassium phosphate	do...	.25
Potassium nitrate	do...	.25
Magnesium sulphate	do...	.25
Iron phosphate		Trace.
Water	liter..	1.00

In the first part of these experiments comparisons were made between plants grown in this solution and those grown in distilled water. The plants experimented with were lupines, rye, wheat, maize, potatoes, buckwheat, hemp, mustard, flax, sunflower, rape, gourds, and castor bean. The only plants reported upon are lupines and rye. The difference in the morphology of the different parts of the plant is given in considerable detail.

In general, the Knop solution increased the number and diameter of the vessels and retarded their lignification in all parts of the lupine.

It also caused the formation of a ring of woody tissue both in the stem and the root, while with the plants in the distilled water the vessels were aggregated in isolated groups, their number and arrangement varying considerably. The Knop solution also thickened the internal portion of the pericycle of the root. It diminished the lignification of the endodermis of the root and admitted of a very considerable development of these cells. It also increased the dimensions of the cells of the bark and pith.

The conclusions reached from the experiments with rye are analogous to those given for the lupine.

In the second part of his work the author studied the special action of each salt, comparing it as before. In this case the plants were grown in series in the Knop solution, one salt being omitted in each series.

It was seen that the morphological characters of the lupine were greatly modified by the different salts. Sulphate of magnesia tends to retard the development of the plant, although it seems to be indispensable. The nitrates of lime and potash are especially valuable to the plant during its earlier periods of growth, but later they become somewhat inefficient, especially the nitrate of potash. The phosphate of potash is absolutely indispensable, and it induces a greater development of roots. Its absence is shown by the atrophy of the roots and elongation of the hypocotyl.

In the experiments with rye it was seen that the growth of the aërial parts of the plants was most active in the solution which did not contain sulphate of magnesia. There was considerable elongation of roots in the absence of nitrates, as observed with the lupines. The phosphate of potash was shown to be indispensable to the growth of both stem and root.

Plat experiments were carried out in which the same solutions were tested by applying them when watering the plants. The results obtained are indicated by curves showing the development of the different parts of the plants for each solution. The experiments conducted in the open air confirm the conclusions already given for the water cultures.

The influence of fruit bearing on the development of mechanical tissue in some fruit trees, A. J. PIETERS (*Ann. Bot., 10* (*1896*), *No. 40, pp. 511–529*).—The author gives a résumé of literature relating to this subject, all the citations being dated since 1878. In his investigations studies were made of shoots of apple, pear, peach, and plum, comparing vegetative and fruit-bearing shoots from the same branch or tree, and as nearly as possible comparable. Free-hand sections were made and the tissues measured with an eye micrometer. Two measurements were taken at right angles to each other and the average thickness of the zones of tissues determined.

The material was studied in reference to the following questions:

"(1) Is the xylem cylinder in a 1-year-old fruit-bearing shoot less well developed than in a vegetative shoot of the same age and apparent vigor, and does it form a smaller proportion of the diameter of the shoot?

"(2) What influence does fruit bearing exert upon the lignification of cell walls?

"(3) Does the fruit-bearing shoot contain any supplementary mechanical tissue formed to supply a possible lack of development in the xylem cylinder?"

The study of the material seemed to warrant the following conclusions:

"(1) The 1-year-old fruit-bearing shoots of the apple and the pear have less wood in proportion to their diameter than the vegetative shoot of the same age. This is due in the apple largely to an increase in the cortex and in the pear solely to a great increase in the cortex and the pith of the fruit-bearing shoot. It does not appear, however, from the structure of the shoots, that the fruit-bearing shoot is weaker than the vegetative. The former is well supplied with supplementary mechanical tissue, which is distributed at those points where it is most needed, and thus gives it an increase of strength for the fruit-bearing year which fully makes up for the difference in xylem development.

"(2) In the peach the fruit-bearing shoot has more wood than the vegetative shoot, and the walls of the wood cells are as thick in the former as in the latter.

"(3) In general it may be said that the effect of fruit bearing upon the tissues is local. In the apple and pear it is perceptible throughout the 1-year-old shoot; in the plum and peach it is confined to a small area in the immediate neighborhood of the fruit stalk.

"(4) The local effects of fruit bearing tend to an increase of cells, with a decrease in the thickness and lignification of the walls of the wood cells. The cortex is especially enlarged, giving rise in the apple and pear to the swollen condition of the fruit-bearing shoot.

"(5) In all cases the increase in growth is greatest on the side near the fruit stalk, although the wood in the apple and pear is best developed on the side of the lateral vegetative bud.

"(6) The local effect of fruit bearing on the wood cylinder disappears with time. The study of apple shoots that had borne fruit during their first year showed that in the 2 or 4 years following there had been a rapid increase of wood, especially on the side of the fruit scar. This side was weakest at the end of the first year. These shoots at the end of 3 and 5 years had a better xylem development than shoots of the same age that had never borne fruit.

"(7) Fruit bearing has a temporary local effect upon the lignification of the walls of the wood cells. It prevents their lignification, wholly or in part, according to their distance from the fruit stalk. The lignification of other cell walls is promoted by fruit bearing. In the fruit stalk the greatest part of the tissue has become lignified, and in the upper part of the apple and pear shoots there is an abundance of well lignified sclerenchyma and hard bast, which is either not found in the vegetative shoot or only sparingly so."

Respiration of wounded plants, H. M. RICHARDS (*Ann. Bot., 10 (1896), No. 40, pp. 531–582, figs. 2*).—The investigations of Böhm[1] and Stich[2] have shown that there was a considerable rise in the amount of carbon dioxid produced by potatoes when injured in various ways. In a subsequent note Böhm[3] gives as a possible explanation of the increased respiration, a traumatic action of the wound, the organ not depending upon the action of the atmospheric oxygen on the tissue. In order to arrive at some definite conclusion regarding this subject the author conducted an extensive series of experiments with potato tubers,

[1] Bot. Ztg., 45 (1887), p. 671.

[2] Flora, 49 (1891), p. 1.

[3] Bot. Centbl., 50 (1892), p. 200.

carrots, red beets, sugar-beet roots, vetch, and cucurbit seedlings, leaves of rhododendron, viburnum, and acacia, shoots of veronica and twigs of *Salix alba*. The apparatus principally used was the Pfeffer-Pettenkofer respiration apparatus with a modified form of Stich's apparatus for determining the equation between oxygen and carbon dioxid. The injury was caused in various ways. Potatoes, carrots, etc., were cut in fours, leaves were slit longitudinally, while with the seedlings the hypocotyl was split or the root tip was cut off. Immediately after injury the parts were washed and partly dried to remove all injured cells and to secure turgidity, after which they were subjected to the conditions of the experiment. The results obtained are tabulated and discussed at considerable length.

The summary of conclusions as stated by the author is as follows:

"(1) That after injury to plant tissue there results a greatly increased respiration, varying in intensity and duration with the character of the tissue involved and with the extent of the wounding. This increased activity of respiration, after reaching—usually within 2 days—a maximum, falls gradually, as the wounds heal over, to a normal or to an almost normal rate.

"(2) That this increased respiration may be ascribed to an effort on the part of the plant to recover from the injury by which the ordinary functions of the plant are stimulated, thereby demanding and necessitating an increased supply of oxygen.

"(3) That in large, bulky tissues there is in the natural condition a certain amount of inclosed or absorbed carbon dioxid, some of which is given off very suddenly during the first 2 or 3 hours after injury, thereby indicating a seemingly higher respiratory activity than in the hours which immediately follow.

"(4) That, in the plants experimented with, the ratio of the absorption of oxygen and production of carbon dioxid does not vary within very wide limits before and after injury, though there is a distinct, if small, increase in the proportion of carbon dioxid given off in the latter case. Also, that the amount of oxygen absorbed is always in excess of the amount theoretically required for the quantity of evolved carbon dioxid."

The influence of continued electric currents on the decomposition of carbon dioxid in aquatic plants, M. THOUVENIN (*Rev. gén. Bot., 8 (1896), No. 95, pp. 435–450, figs. 9*).—The author has investigated the decomposition of carbon dioxid and liberation of oxygen as affected by a weak continuous electric current. Aquatic plants were so placed in water charged with carbon dioxid that a current of electricity could be passed through them and the oxygen bubbles observed, collected, and analyzed. The plants were placed in the sunlight so that the activity of the chlorophyll would not be impaired. The plants experimented with were *Elodea canadensis*, *Myriophyllum spicatum*, and *Potamogeton perfoliatus*. The number of bubbles of oxygen observed was very appreciably increased when the plant was electrified, in some cases they were given off too rapidly to be counted.

Two possible objections are raised to the results, namely, the current may electrolyze the water, or it may decompose the carbon dioxid in it, and in either case oxygen would be given off. These are met with the statement that in no case was the current sufficiently strong for the purpose, 0.0035 amperes being the strongest employed, and when the plant

was placed in water to which was added a quantity of chloroform sufficient to suspend the activity of the chlorophyll no gas was liberated. even when the current was passed through the plant.

The conclusions drawn from the experiments show that a continuous electric current favors the assimilation of carbon in accelerating the decomposition of carbon dioxid in aquatic plants. There is evidently an optimum intensity of current beyond which the action of the electricity may become injurious, but this varies with the individual plant and is not constant for a given species.

Report of the botanist, F. L. HARVEY (*Maine Sta. Rpt. 1895, pp. 89–98*).—A report is given of the more important investigations of the year. A list of about 20 species of weeds is enumerated and all are briefly described. Fungus diseases did but little harm during the year. An account is given of the second blooming of some pear trees, and various suggestions are offered as probable causes of this phenomenon. The cause in the particular case under consideration was insect attacks, the foliage having been completely destroyed earlier in the season.

Report of the botanical investigations for the year 1894–'95, STEFFEK and SCHUMANN (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 93–97*).—During the year there were made in the botanical laboratory 3,286 examinations of all kinds. Of this number 2,645 were seed tests, 591 were microscopical examinations of concentrated feeding stuffs, and 50 were bacteriological investigations of water. Of the seed tests, which increased over 600 samples from the previous year, 2,156 lots were beet seed, an increase in the number of tests of this particular kind of seed of 1,037 samples over the previous year.

In the examination of feeding stuffs it was found that 37 per cent of the samples were adulterated with gypsum, sulphate of barium, or inferior feeding stuffs. As a rule, the samples of cotton-seed cake and meal were not adulterated. Of the samples of peanut meal, 8.82 per cent were falsified; of rape cake, 40.5 per cent; of flaxseed cake, 38.5 per cent; and of rye bran, 54.5 per cent of all samples were adulterated.

Miscellaneous notes and descriptions of new species (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 36–39, pls. 2*).—Descriptions are given of *Paspalum scabrum* Scrib., *Ichanthus lanceolatus* Scrib. & Smith, *Triodia drummondii* Scrib. & Kearney, *Elymus robustus* Scrib. & Smith, *E. intermedius* Scrib. & Smith, and *E. angustus* Trin., all of which are new except the last. The first 2 species are figured. Notes are given on the genus *Chætochloa* Scrib., a new name proposed in place of *Setaria* Beauv., *Chamæraphis* Kuntze, and *Ixophorus* Nash.

The genus Ixophorus, F. LAMSON-SCRIBNER (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 5–7, pls. 2*).—The author discusses the synonymy of the genus Ixophorus, which has been variously confused with Panicum and Setaria. He considers that Ixophorus can not include all the species of Setaria. A revision of the genus is given in which 2 species and 1 variety are included.

On the structure and development of the fruit of Citrus vulgaris, M. BIERMANN (*Arch. Pharm., 235 (1897), No. 1, pp. 19–28*).

The osmotic activity of the cell in its pharmacological and toxicological relations with special reference to ammonia and alkaloids, E. OVERTON (*Festschr. Naturf. Ges. Zurich, 1896, II, pp. 383–406*).

Concerning the periodical movement of leaves of Mimosa pudica in a dark room, L. JOST (*Bot. Ztg., 55 (1897), I, No. 2, pp. 17–48*).

Pathological hypertrophy of plant cells, M. MALLIARD (*Rev. gén. Bot., 9 (1897), No. 98, pp. 33–44, pls. 2*).—Notes are given upon the pathological effect of galls on the plant cell.

Concerning vegetable oxidizing ferments, especially in Phytolacca decandra, E. SCHÄR (*Festschr. Naturf. Ges. Zurich, 1896, II, pp. 233–253*).

The method of attachment and host plants for mistletoe, MÄUNEL (*Forstl. naturw. Ztschr., 6 (1897), No. 2, pp. 60–65, pl. 1*).

Sclerotinia heteroica, M. WORONIN and S. NAWASCHIN (*Ztschr. Pflanzenkrank., 6 (1896), No. 4, pp. 199–207, pl. 1*).—This is the concluding paper of the authors' study of this fungus.

Culture experiments with heterœcious rust fungi, V, H. KLEBAHN (*Ztschr. Pflanzenkrank., 6 (1896), No. 6, pp. 324–338*).—This is the concluding number of the report for 1896 of investigations on heterœcism.

Concerning the origin and physiological relations of the root tubercles of legumes, L. HILTNER (*Forstl. naturw. Ztschr., 6 (1897), No. 1, pp. 23–36*).—A résumé of our knowledge relative to the function of the root tubercles of legumes.

Concerning parasymbiosis, W. ZOPF (*Ber. deut. bot. Ges., 15 (1897), No. 1, pp. 90–92*).

Variation and environment, C. T. DRURY (*Gard. Chron., ser. 3, 21 (1897), No. 531, pp. 133, 134*).

Native and introduced species of the genera Hordeum and Agropyrum, F. LAMSON-SCRIBNER and J. G. SMITH (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 23–36*).—Revisions are given of the genera Hordeum and Agropyrum as represented in the United States. Ten species of Hordeum, one of which, *H. boreale*, is new, are known to occur in the United States. In the revision of the genus Agropyrum the authors recognize 23 species and numerous varieties, of which 10 species and 14 varieties are new. The new species described are *Agropyrum vaseyi*, *A. arizonicum*, *A. parishii*, *A. gmelini*, *A. tetrastachys*, *A. albicans*, *A. spicatum*, *A. lanceolatum*, *A. pseudorepens*, and *A. riparium*.

Some American Panicums in the Herbarium Berolinense and in the herbarium of Willdenow, T. HOLM (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 17–23, figs. 9*).—A report is given on certain species of Panicums in the Berlin and Willdenow herbariums based on a study made by the author in 1894.

Some Mexican grasses collected by E. W. Nelson in Mexico, 1894–'95, F. LAMSON-SCRIBNER and J. G. SMITH (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 11–16, pl. 1, figs. 2*).—A list of species, descriptions of new species, and various critical notes on the distribution and economic value of different grasses represented in this collection are given.

A list of the grasses collected by E. Palmer in the vicinity of Acapulco, Mexico, 1894–'95, F. LAMSON-SCRIBNER (*U. S. Dept. Agr., Division of Agrostology Bul. 4, pp. 7–11, figs. 4*).—A list of species is given, together with statements relative to the habitat, distribution, and economic value of grasses in the collection of Edward Palmer. A new genus, Fourniera, is figured and described.

Mississippi fungi, S. M. TRACY and F. S. EARLE (*Mississippi Sta. Bul. 38, pp. 136–153*).—This bulletin is a continuation of Bulletin 34 of the station and contains additional fungi which have been observed since the date of publication of that bulletin. Since the publication of the previous report, 85 species, 21 of which are new, have been added to the list, making the total number given in the two lists 133 genera and 433 species. No attempt has been made to enumerate the fleshy fungi, and many other important groups have received but slight attention. In the present bulletin several species are described for the first time.

Flowering plants and ferns, J. C. WILLIS (*The Macmillan Co., New York, 1897, 2 vols., pp. IX, 224, and XIII, 429, figs. 23*).—This work presents in a convenient form a summary of useful and scientific information about the plants met with in the botanic garden, museum, or field. It treats of morphology, classification, distribution, natural history, economic botany, etc., giving such information as is usually required which does not need the use of a compound microscope for its study. The principal part of the book consists of a dictionary in which all the families and the more

important genera of flowering plants and ferns are alphabetically arranged. The figures, which on account of the scope of the work are necessarily few in number, consist of floral diagrams of some of the larger families as well as of some groups whose morphology is particularly difficult. The principles of morphology, classification, and evolution are clearly presented, and the information is for the most part brought up to date. Much duplication is avoided by a system of cross references, making the book reasonably complete but not bulky.

ZOÖLOGY.

Four common birds of the farm and garden, S. D. JUDD (*U. S. Dept. Agr. Yearbook 1895, pp. 405–418, figs. 106–109*).—From an examination of the stomachs of 213 catbirds, 15 mockingbirds, 121 brown thrashers, and 52 house wrens, the author concludes that the wren is most, and the catbird the least, beneficial, judging from the proportion of animal to vegetable matter eaten. The general character of the food of all but the mockingbird he tabulates as follows:

Food of the catbird, brown thrasher, and house wren.

	Catbird.	Brown thrasher.	House wren.
Animal food:	*Per cent.*	*Per cent.*	*Per cent.*
Ants	10	5	4
Caterpillars (Lepidoptera)	5	8	16
Beetles (Coleoptera)	14	28	22
Grasshoppers, etc. (Orthoptera)	4	12	25
Bugs (Hemiptera)	2	2	12
Spiders and thousand-legs, etc. (Arachnida and Myriapoda)	4	7	14
Miscellaneous animal food	5	1	5
Total animal food	44	63	98
Vegetable food:			
Cultivated fruits	18	8	....
Wild fruits	35	24	....
Grain	....	3	....
Miscellaneous vegetable food	2	....	1
Total vegetable food	55	35	1

The 15 mockingbirds were taken during autumn and winter, a time when the vegetable is in excess of the animal food. Their stomachs contained the skins and pulp of some fruit, seeds of sumach, smilax, black alder, poison ivy, Virginia creeper, and cedar; poke berry, mulberry, and bayberry, and the remains of spiders, ants, caterpillars, beetles, and grasshoppers.

To protect against the depredations of the catbird upon cherries, strawberries, etc., it is suggested that mulberry trees be planted nearby, since the birds seem to prefer the latter. Reports indicate that the catbird pillages fruit crops less along the seaboard where wild fruits are abundant than in the interior where such fruits are scarce; hence the growth of wild fruits should be encouraged.

The proportion of animal food to vegetable food eaten by catbirds is shown to vary with the season. From observations in the field the birds seemed to devote themselves to berries rather than insects; but examination of the stomachs of 13 of the 15 birds watched showed that

9 had eaten the orange and black locust beetle. 18 of these being taken from one stomach.

To determine whether wild fruits are preferred to cultivated fruits and noxious insects to beneficial insects, a number of experiments were made with captive birds. From these it appears that smooth caterpillars, maggots, ants, and spiders are relished; that beetles of the family Lampyridæ may be eaten under stress of hunger, and that hairy caterpillars, butterflies, honeybees, slugs, sow bugs, and plant lice are not relished. Thousand legs may be taken. Earthworms were not found at all, and the author suggests that these are not eaten by birds, including the robin, to such an extent as is commonly supposed.

With respect to the brown thrasher, more or less similar conclusions are arrived at, but the proportion of animal to vegetable food is much greater, being 63.35 for the season as compared with 44.55 for the catbird for the same period.

The bird's preferences are shown by the fact that of its animal food nearly one-half consists of beetles, one-fifth of grasshoppers and crickets, a little less of caterpillars, and one-tenth of spiders and thousand legs.

The vegetable food of the wren, as shown by the table, amounts to only 1 per cent, and the author suggests that this may have been taken by accident.

The meadow lark and Baltimore oriole, F. E. L. BEAL (*U. S. Dept. Agr. Yearbook 1895, pp. 419–430, figs. 2*).—The examination of 238 stomachs of the meadow lark, collected from 24 States, the District of Columbia, and Canada, and representing every month in the year, demonstrates that the bird is most emphatically insectivorous, although in the absence of its favorite food it is capable of subsisting upon a vegetable diet. This latter fact, the author points out, renders the bird more valuable than if it were exclusively insectivorous, since such a capability enables it to bridge over periods of scarcity in its favorite food by comparatively short migrations.

The total amount of vegetable food for the entire year was found to be only 27 per cent, 11.1 per cent being corn, 1.8 wheat, and 1.4 per cent oats. The greatest amount of grain was eaten during January; and during the summer this was entirely replaced by insect food. Sprouting grain was not found in a single case.

Much the greater portion of the vegetable diet consisted of weed seeds, and some of these were found throughout the year, except the month of May, the greatest amount being found in December, with one exception.

Newly sown clover seed was found in only 6 stomachs out of the whole 238 examined. During harvest the grain eaten amounted to less than 1 per cent, and during November, when insect food usually begins to fail, the grain amounted to only 6 per cent, while weed seeds (Ambrosia, Chamæraphis, etc.) reached as high as 15 per cent.

For the entire year 71.7 per cent of the food was composed of insects and 26.5 vegetable material, the remaining 1.8 per cent being mineral

matter. In spite of the fact that insects are not readily found during March, December, and January, they formed 73.39 and 24 per cent, respectively, of the food of the meadow lark during these months. The general character of the animal food is shown by the following statement:

Animal food of the meadow lark.

	Per cent.
Orthoptera (grasshoppers, locusts, and crickets)	29.0
Coleoptera: May beetles, 4; Rhycophora, 3; other forms representing about 12 families, 3; Carabidæ, 7	18.0
Lepidopterous larvæ	8.0
Hemiptera	4.0
Coleopterous larvæ	3.0
Ants	3.0
Other hymenoptera (wasps, etc.)	1.5
Spiders, myriapods, etc	5.0
Other animal matter	.2
Total animal matter	71.7

In the case of the Baltimore oriole examination was made of 113 stomachs of birds collected from 12 States, the District of Columbia, and Canada, and ranging from Massachusetts to Kansas and North Dakota. All were, with one exception, taken during the months from April to August, inclusive. The following table shows the approximate percentage of the principal animal food for the 6 months:

Food of the Baltimore oriole.

	April.	May.	June.	July.	August.	November.	6 months.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Caterpillars	25	25	25	12		81	34.0
Beetles:							
Elateridæ		9	9	9			4.5
May beetles		12	7				3.5
Chrysomelidæ				8	5		3.0
Rhyncophora		5		2	2		2.0
Carabidæ							.5
Hymenoptera	20			8			11.0
Ants (mostly Camponotus)	10	10					
Hemiptera		4		10	4		6.0
Diptera		4				7	
Orthoptera			1	11	17		
Spiders		5			12		6.0

For the 6 months 83.4 per cent of the total food was animal and 16.6 per cent vegetable.

Among the noteworthy facts are the proportion of caterpillars eaten, the taste shown for wireworms (Elateridæ) and the very small proportion of useful insects (Carabidæ) destroyed.

A still further remarkable fact is that among the Hemiptera are included scale lice and plant lice. The former were found in 8 and the latter in 4 stomachs.

Our home birds, B. H. WARREN (*Pennsylvania Sta. Rpt. 1895, pp. 244–265*).—In this largely compiled report the author treats very popularly the more common birds of prey, sparrows, and warblers included among the more than 300 avian species and subspecies recorded either as resident or as transitory visitors in the State. The promiscuous

shooting of birds of prey and the destruction of plumage birds is deprecated. The wholesale destruction of the English sparrow is not advised, for fear that many of the noninjurious birds may be mistaken for it. The payment of bounties for birds by the State is discountenanced, for it has been learned from correspondence that a large number of birds condemned by many farmers and sportsmen as injurious are not guilty of the harm attributed to them.

Of the hawks, the sparrow hawk (*Falco sparverius*) is accredited with doing much good by destroying large numbers of field mice as well as great numbers of grasshoppers and other insects. The little harm the bird does in catching a few chickens during its breeding season is believed to be more than recompensed by the good that it does.

The food of owls consists largely of small quadrupeds, and, with the exception of the great horned owl and possibly also the barred owl, all the owls occurring within the State (some 10 species) are worthy of the fullest protection.

The good that the warblers—some 40 of which occur in the State—might do if protected instead of being killed for their plumage is shown by citing the great loss from insect ravages in the United States in general, and in several States in particular. For Pennsylvania, the author thinks, a conservative estimate for such loss would be about $5,000,000.

Investigations concerning the contents of the stomach of the rook (Corvus frugilegus), M. HOLLRUNG (*Vers. Stat. Pflanzenschutz, Halle, 7 (1895), pp. 5–26*).

Birds as protectors of orchards, E. H. FORBUSH (*Rpt. Ontario Ent. Soc. 1895, pp. 53–62, figs. 5; repr. from The Museum*).—Notes on the food of birds as determined by examinations of stomachs and otherwise.

A preliminary list of the birds of Wayne County, Ohio, H. C. OBERHOLSER (*Ohio Sta. Bul., tech. ser., vol. 1, No. 4, pp. 243–354, figs. 21*).—Descriptive and critical notes are given on 183 species of birds known to inhabit the region indicated, together with a hypothetical list of 82 others which are thought to be occasional visitors.

METEOROLOGY.

Arizona weather, E. M. BOGGS (*Arizona Sta. Bul. 20, pp. 38*).—Summaries of observations on temperature, pressure, precipitation, humidity, evaporation, sunshine, and wind movement in the vicinity of Tucson and at other points in the Territory during about 4 years ending June, 1895, are tabulated and discussed, the data being compared with similar data obtained at important cities in other parts of the United States.

The most notable feature of the climate of Arizona is the deficiency of moisture.

"Not only is the rainfall of southern Arizona very light, but it occurs on very few days of the year. The winter months are especially free from rainy days. . . .

"The maximum winter temperatures of southern Arizona are very nearly the same as those of the Gulf States. Those of summer are considerably higher, but the [low] relative humidity shows unmistakably why the summer climate of Arizona is far less trying than that of the States bordering on the Gulf of Mexico. Thus the June temperature of 107° at Tucson with relative humidity at only 22 per cent is far preferable to that of cities with temperatures of 85 to 95° and humidity at 65 to 83 per cent. . . .

"In common with the arid region in general, Arizona usually experiences a large daily range of temperature, [but this also] is mitigated to a great extent by the prevalent low degree of humidity."

The percentage of sunshine (77) was higher at Tucson in 1893 than at any of the 24 stations reporting that element in that year.

Meteorological observations, W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1895, pp. 268–272, 288–325*).—The meteorological work of the station in 1895 was "merely a continuation of the work of preceding years, including the observations usually called for by the United States Weather Bureau, upon atmospheric conditions, and also observations upon soil temperature at various depths, and upon the daily duration of sunshine." (E. S. R., 6, p. 701.) Monthly summaries of observations are given in the body of the report, and the detailed record in an appendix. The annual summary is as follows:

Summary of meteorological observations, 1895.

	Year 1895.	Growing season (Apr. to Sept., 1895).
Barometer (inches):		
Mean	30.306	
Highest	30.796 (Feb. 24)	
Lowest	29.459 (Jan. 29)	
Temperature (° F.):		
Mean	50.6	47.6.
Highest	96 (July 19)	96 (July 19).
Lowest	—4 (Dec. 4)	18 (Apr. 3).
Mean daily range	18.3	20.2.
Greatest daily range	36 (Feb. 17, Sept. 2)	36 (Sept. 2).
Least daily range	3 (Apr. 11, Dec. 1)	
Mean daily relative humidity (per cent)	79.9	76.5.
Rainfall (inches):		
Total	42.1	28.01.
Greatest monthly	9.5	
Greatest daily	2.8	2.79 (May 20).
Number of days on which 0.01 in. or more of rain fell.	125	73.
Mean percentage of cloudiness	53	52.
Number of days on which cloudiness averaged 80 per cent or more.	150	74.
Average hours of sunshine per day		5 h. 37 m.
Wind (miles):		
Total movement	30.281	
Maximum velocity	35 (Feb. 11, Dec. 13)	
Greatest daily movement	492 (Feb. 22)	
Last frost in spring		May 29.
First frost in fall		Sept. 26.

Principal periods of crop development.

Wheat:
- Seeded, September 4–14, 1894.
- In bloom, May 31.
- Ripening, June 14–18.
- Cut, July 1–5.

Oats:
- Seeded, April 10–19.
- Ripening, July 12–17.
- Cut, August 5–9.

Corn:
- Planted, May 2–10.
- Cut, September 13–25.

Corn—Continued.
- Husking begun, October 1.

Potatoes:
- Planted, April 25–May 3.
- Harvested, September 6–13.

Grass:
- In bloom, June 13.
- Cut, June 18–28.

Clover:
- Cut, June 14–16.
- Second crop in bloom, August 2.

Determination of atmospheric ozone on Mont Blanc, M. DE THIERRY (*Compt. Rend., 124 (1897), No. 9, pp. 460–463*).

The gases of the atmosphere: The history of their discovery, W. RAMSAY (*London: Macmillan & Co., 1896, pp. 240; noted in Nature, 55 (1897), No. 1428, p. 435*).

Report of the International Meteorological Congress at Chicago, Illinois, August 21–24, 1893 (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 3, pp. 585–772, pls. 18, fig. 1*).—This report[1] is edited by O. L. Fassig, and contains the following articles: The climate of the United States, by H. A. Hazen; the climate of the West Indies, by M. Hall; the climate of the City of Mexico, by M. Bárcena; the climate of the British Islands, by C. Harding; the climate of the Netherlands, by M. Snellen; the climate of Denmark, by A. Paulsen; the climate of Norway, by H. Mohn; the development of climatology in the German Empire, by H. Meyer; references to sources of information relative to the climate of Austria-Hungary, by J. Hann; meteorology of the Italian Mountains, by F. Denza; the climate of the Malay Archipelago, by J. P. Van der Stok; the climatology of southern and western Asia, by M. L. Dallas; historical sketch of instrumental meteorology, by E. Gerland; the relative merits of anemometers in general use, by W. H. Dines; relative merits of the various types of registering maximum and minimum thermometers, by D. Draper; on the construction of registering air thermometers to replace the ordinary alcohol and mercurial thermometers, by A. Sprung; observations of solar radiation—how best made and compiled, by O. Schwolson; the study of the upper atmosphere by means of balloons, by V. Kremser; observations of atmospheric dust, by J. Aitken; the study of the upper atmosphere from observations on mountain stations, by J. Hann; the study of the upper atmosphere by means of cloud observations, by Vettin; cloud photography, by A. Angot.

SOILS.

Soil ferments important in agriculture, H. W. WILEY (*U. S. Dept. Agr. Yearbook 1895, pp. 69–102, figs. 2*).—A general discussion of the vital activity of the soil, especially the fixation of nitrogen by the soil, nitrification, and the assimilation of nitrogen by leguminous plants in symbiosis with microörganisms, with suggestions regarding the application in farm operations of the scientific discoveries along these lines. The importance of further study in this direction, with a view to finding methods for securing "the greatest activity of the beneficial organisms and the least activity of the inimical ones," is pointed out.

The progress of nitrification in the soil is illustrated in a diagram showing the results of observations on a culture inoculated with organisms from an Alabama soil.

"The diagram shows that no action took place during the first two weeks after seeding. During the third week there was a vigorous evolution of nitrous acid, with only a trace of nitric acid. During the fourth week, attending a depression of temperature, the bacterial action was less active. During the fifth week both the nitrous and nitric organisms were active, attending a considerable rise of temperature. After the fifth week the nitrous acid began rapidly to disappear, being converted into nitric acid. The horizontal position, however, of the continuous line shows that no additional nitrous acid was formed from the ammonia during the sixth week. During the seventh week there was no activity either of the nitrous or the nitric ferment. During the eighth and ninth weeks both ferments were again active, the nitrous acid being converted into nitric as soon as formed."

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[1] For notices of papers in parts 1 and 2 of this report see E. S. R., 5, p. 1086; 6, pp. 507, 618, 639, 695; 7, pp. 280, 285.

Another diagram shows "that there is in general quite a marked agreement between the rate of nitrification and the degree of temperature."

Soil temperatures, W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1895, pp. 273–287, 326–349*).—A record is given of tridaily observations during 1895 with thermometers at the surface and at depths of from 1 to 24 in.

The following is a summary of observations during the growing season:

Soil temperatures, April to September, 1895.

Depth.	Highest.	Lowest.	Daily mean.	Mean daily range.	Greatest daily range.
	Deg. F.	*Deg. F.*	*Deg. F*	*Deg. F.*	*Deg. F.*
At surface	101.0 (July 18)	31 (Apr. 3)	64.1	9.42	26.0 (July 10).
1 in. deep	89.5 (July 1)	33 (Apr. 3)	64.5	7.74	18.0 (June 21).
3 in. deep	83.0 (July 19)	34 (Apr. 3)	63.3	5.73	11.5 (June 21).
6 in. deep	81.0 (July 19)	36 (Apr. 13)	64.0	3.82	8.5 (June 21).
12 in. deep	77.0 (July 19)	38 (Apr. 12, 13)	63.2	1.32	4.5 (June 10).
24 in. deep	73.0 (July 21)	39 (Apr. 1, 13, 14)	61.4	.25	1.0 (Apr. 17).

Origin, value, and reclamation of alkali lands, E. W. HILGARD (*U. S. Dept. Agr. Yearbook 1895, pp. 103–122, pl. 1, figs. 5*).—A discussion of the occurrence, characteristics, and injurious effect of alkali soils; influence of irrigation on the movement of alkali; composition of alkali salts; the utilization and reclamation of alkali lands; and crops suitable for alkali lands.

On the origin of humus, S. BENNI (*Inaug. Diss. Giessen, 1896, pp. 32; Ztschr. Naturw., 69, pp. 145–176; Bot. Centbl., 69 (1897), No. 2–3, p. 88; Chem. Centbl., 1897, I, No. 1, p. 31*).

Humus in its relation to soil fertility, H. SNYDER (*U. S. Dept. Agr. Yearbook 1895, pp. 131–142*).—The nature and functions of humus are explained, and its influence on temperature, tilth, permeability, absorptive power, weight, and color, and on water, nitrogen, phosphoric acid, and potash contents of the soil is discussed.

The influence of various moist soils on the growth of plants, PERSEKE (*Fühling's landw. Ztg., 46 (1897), No. 3, pp. 75–78*).

The exhaustion of an originally very fertile soil by a long-continued system of soil robbery, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat., Halle, 1895, pp. 79–86*).—An account is given of the system of farming without manure which has been practiced on the Oldenburg marsh soils since 1659, condensed from *Zusammensetzung und Düngerbedürfnis Oldenburger Marscherden und deren Bewirtschaftung, M. Maercker. Paul Parey, 1896.*

The effect of shading the soil (*Sci. Amer., 76 (1897), No. 7, p. 101*).

Cultivation of heavy soils, T. HOPPENSTEDT (*Die Kultur des schweren Bodens. Berlin: Paul Parey, 1897*).

Reasons for cultivating the soil, M. WHITNEY (*U. S. Dept. Agr. Yearbook 1895, pp. 123–130*).—How water enters the soil is explained and the principles and effects on the water content of the soil of plowing, subsoiling, cultivating, underdraining, and irrigation are discussed, the whole being summed up in the statement that "the object of all cultivation, in its broadest aspect is to maintain, under existing climatic conditions, a uniform and adequate supply of water and air in soils adapted to different classes of plants. This is the object alike of plowing, subsoiling, cultivation, underdrainage, and irrigation; they are all processes to be used in maintaining suitable moisture conditions for the growth of crops."

On the cultivation of the soil, TANCRÉ (*Fühling's landw. Ztg., 46 (1897), No. 4, pp. 98–105*).

Moors and moor culture in Bavaria, A. BAUMANN (*Forstl. naturw. Ztschr., 6, (1897), No. 2, pp. 69–89*).

FERTILIZERS.

Some Pennsylvania peats, W. FREAR and E. J. HALEY (*Pennsylvania Sta. Rpt. 1895, pp. 143–156*).—The character, extent, and reclamation of peat bogs in the State are discussed and analyses of 13 samples with directions for use as fertilizers are given. In the dry matter of the samples examined the ash ranged from 5.3 to 95.54 per cent, nitrogen from 0.12 to 3.42 per cent, phosphoric acid from 0.10 to 0.89 per cent, potash from 0.05 to 1.96 per cent, lime from 0.88 to 11.62 per cent.

"In general, it may be said that to buy the nitrogen, phosphoric acid, and potash present in a ton of the dry matter of these peats, even buying the cheapest materials rated good, would require, without considering bagging, freight, and commission, from $2.50 to over $15.

"These data show that we possess in this State many peat beds whose economical use is well worth the most careful consideration, despite the great cost of handling fertilizers so bulky and dilute. . . . If the peat already contains considerable silt rich in lime, all it needs is to be thrown up in heaps to drain and allowed to stand exposed to the air, the longer if lower oxids of iron and sulphids are present.

"If, however, as is commonly the case, lime salts are deficient, the muck must be composted."

Directions are given for making alkaline composts and composts with stable manure.

Investigations on the foraging powers of some agricultural plants for phosphoric acid, L. H. MERRILL and W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 10–18, pls. 5, fig. 1*).—This is a continuation of work begun in 1893 (E. S. R., 6, p. 709). The plan of the experiment was the same as that previously followed. The phosphates compared were (1) acidulated Florida rock (14.97 per cent soluble phosphoric acid, 16.9 available, 3.7 insoluble); (2) crude, finely ground Florida rock (32.88 per cent phosphoric acid); and (3) phosphate of iron and alumina (49.58 per cent of phosphoric acid, 42.77 per cent soluble in ammonium citrate).

"Eight species of plants were chosen, representing 4 orders: Peas and clover (Leguminosæ), turnips and ruta-bagas (Cruciferæ), barley and corn (Gramineæ), and tomatoes and potatoes (Solanaceæ).

"Ninety-six boxes were used, 12 for each kind of plant. In the first box the acid rock was used; in the second, the crude rock; in the third, the phosphate of iron and alumina; in the fourth, no phosphate. The next 4 boxes were treated in the same manner, and so on to the end. Thus it will be seen that for each kind of plant there were 3 boxes which received the same treatment.

"Twenty grams of the crude Florida rock, containing 6.576 gm. total phosphoric acid, were used for a single box. Of the other phosphates such quantities were used as contained the same total amount, 6.576 gm., of phosphoric acid.

"To each box were also added 10 gm. sodium nitrate, 5 gm. potassium chlorid, and 5 gm. magnesium sulphate. To the boxes containing the phosphate of iron

and alumina and to those containing no phosphate were also added 10 gm. calcium sulphate. . . .

"The experiments were continued through 3 periods. In the first period the barley matured its heads and many of the pea pods were well filled. The second period extended through the shortest days of the winter, when the lack of sun and the lower temperature were unfavorable to the best development of the corn and tomatoes. The third period was made shorter than the others, and none of the plants reached their full development."

The data, which are given in tables and diagrams, are thus summarized:

"(1) All the plants receiving the phosphate of iron and alumina show a gain over those receiving no phosphate. This effect was most marked with the corn, the yield being 3 times as great as where no phosphate was used. The weight of the tomato plants was doubled. The turnips and ruta-bagas responded vigorously, the crop of roots being doubled. On the other hand, the peas and potatoes gained but little

"(2) All the plants receiving the insoluble Florida rock show a gain over those to which no phospate was given, the crops of clover, ruta-bagas, corn, tomatoes, and ruta-baga roots being more than doubled. The barley, potatoes, and especially the potato tubers, gained but little. All the plants showed a gain over those receiving the phosphate of iron and alumina except in the case of the barley, corn, turnip roots, and potato tubers.

"(3) All the plants were benefited by the addition of the acid rock. The barley and corn show the most marked increase, the yield being double that from the crude rock. The ruta-bagas and the turnips derived nearly as much benefit from the crude rock as from the acid rock.

"The effect of the acid rock was very marked with all the plants grown, those receiving it in nearly all cases at once taking the lead and keeping it to the end. The plants were darker green in color, and the tubercles, which were developed on the roots of nearly all the leguminous plants, were larger and much more numerous. It was noticeable, however, that in some cases, especially with the clover, turnips, and ruta-bagas, the good effects of the acid rock were more marked during the first few weeks of growth than at a later stage, when the roots had become more fully developed and had begun to forage for themselves. It would appear that the young plants feed but little upon the insoluble phosphates; but that the organic acids present in the sap of the roots exert a solvent action upon the insoluble phosphates in the soil, gradually converting them into available forms."

The results indicate that although the soluble phosphoric acid was the most available the insoluble forms were used to a considerable though varying extent by the different plants. The solubility in ammonium citrate was not a true measure of the availability of the phosphoric acid to the plants. "The ability to appropriate water-insoluble phosphoric acid appeared with some species of plants to greatly increase as the plants developed."

The fertilizing effect of the nitrogen of different green manuring plants, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 40, 41*).—Equal amounts (1.5 gm.) of nitrogen in the form of nitrate of soda, *Lathyrus sylvestris wagneri*, alfalfa, red clover, and esparcet were applied to white mustard grown in pots on sandy soil. The effectiveness of the green manures was in the order given above and appeared

to correspond with the proportion of amid nitrogen which the plants contain, as shown in the following table:

Proportion of total nitrogen in different crops in form of amid compounds.

	Per cent.
Lathyrus sylvestris wagneri	27.2
Alfalfa	23.1
Red clover	16.4
Esparcet	11.3

Experiments with various manure preservatives, M. MAERCKER and SCHULTZE (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 32–40*).—In these experiments, which were begun in 1894, 0.5 kg. of cow dung was mixed with 1.75 kg. of urine, the object being to make the ratio of urine nitrogen to dung nitrogen 3 : 1. As an absorbent 0.5 kg. of peat was used and the following preservatives were added in different cases: Superphosphate, potassium fluorid, sulphuric acid, and lime. The main results are given in the following table:

Loss of nitrogen from manure in percentages of the original nitrogen.

Manure and preservative used.	After 2 months.	After 5 months.	After 10 months.
	Per cent.	*Per cent.*	*Per cent.*
Cow manure alone	8.80	26.36	30.63
Cow manure and urine	16.51	47.10	55.69
Manure mixture (cow dung 0.5 kg., urine 1.75 kg., and peat 0.5 kg.)	13.15	20.11	17.92
Manure mixture with 12.41 gm. superphosphates (¾ lb. per head daily)	9.17	18.59	12.70
Manure mixture with 49.64 gm. superphosphates (3 lbs. per head daily)	2.43	7.89	.97
Manure mixture with 1.037 gm. potassium fluorid	3.88	6.95	.21
Manure mixture with 5.185 gm. potassium fluorid	8.39	12.22	4.82
Manure mixture with ½ per cent sulphuric acid	1.89	5.82	1.48
Manure mixture with 1 per cent sulphuric acid	3.70	4.05	3.79
Manure mixture with 56.2 gm. caustic lime	14.85	15.13	11.55

It will be observed that the loss is large from both the dung and the mixture of dung and urine, amounting in the latter case to 55.69 per cent in 10 months. The addition of peat had a very decided influence in reducing the loss. It is explained that the increase of nitrogen after 10 months in this case is due to the fact that the peat caused the manure to become acid and it absorbed nitrogen compounds from the air. Soluble phosphoric acid in the amounts usually applied in practice ¾ lb. per head of cattle, adds nothing to the preservative effect of the peat. The larger application, however, was very effective. The same was true of the fluorid and sulphuric acid.

The behavior of the lime was somewhat remarkable. Immediately after it was added there was a very strong odor of ammonia, but the loss of nitrogen was not very great. After 6 days it amounted to 6.15 per cent of the original nitrogen, after 36 days to 8.29 per cent, after 57 days 14.85 per cent, and after 161 days 15.13 per cent. During the 161 days the loss was thus less than from the mixture of dung, urine, and peat without preservatives.

Vegetation experiments at this station have shown that the albuminoid nitrogen of manure has very little fertilizing effect, while the nitrogen in urine stands between ammonia salts and nitrates in this respect, and the amid nitrogen is about as effective as the nitrogen of the urine. For this reason the effect of the different methods of treatment upon the forms of nitrogen in the manure was studied in the experiments here reported. It was found that under the influence of putrefaction there was a decrease of albuminoid nitrogen and an increase of amid nitrogen in every case during the first 16 days, but that thereafter under the influence of microörganisms there was generally an increase of albuminoid nitrogen, this increase being especially marked in case of the lot to which lime had been applied. The lime, therefore, in spite of its preservative effect, reduced the fertilizing value of the nitrogen of the manure. It favored the production of ammonia and probably as a consequence nitrification. The opposite results in these respects were produced by the use of sulphuric acid, the larger application of which preserved the manure about in its original condition as regards ammoniacal and nitric nitrogen. The phosphoric acid produced an effect intermediate between that of the lime and the sulphuric acid. Although the largest amounts of nitric nitrogen were not produced in the cases of the last two preservatives, the largest amount of readily available nitrogen was present in the manure treated with them, as shown by analysis and by vegetation experiments with white mustard. The more important data of these experiments are given in the following table:

Effectiveness of nitrogen in manure treated in different ways.

Kind of manure and treatment.	Amount of total nitrogen theoretically available.	Relative effectiveness.
	Per cent.	
Nitrate of soda	100.00	100.0
Manure without treatment	15.08	6.5
Manure treated with the smaller amount of phosphoric acid	38.19	20.4
Manure treated with the larger amount of phosphoric acid	53.53	48.6
Manure treated with the smaller amount of sulphuric acid	54.46	51.7
Manure treated with lime	59.90	36.1

It appears from these experiments that when manure is not properly preserved a considerable part of the nitrogen is lost and the theoretical effect of that which remains is not obtained. It is advisable, therefore, when preservatives are employed to use them liberally.

The loss of nitrogen in barnyard manure in the heap, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 77, 78*).—In a sample of manure kept in a barrel with a loose cover for $2\frac{1}{2}$ months, the percentage of total nitrogen in albumincid form increased from 59.73 to 88.81, and the nitrogen in other forms decreased from 40.27 to 11.19 per cent. In manure stored in heaps in the ordinary

way the available nitrogen decreased in $2\frac{1}{2}$ months from 21.56 to 5.94 per cent.

Pot experiments with these two manures on white mustard grown on sandy loam soils showed that the fertilizing effect in case of the first was very small, and in case of the second practically nil.

Experiments on the fertilizing effect of barnyard manure and of its different constituents, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 41–56*).—Experiments on oats grown on sandy loam and on white mustard grown on sandy soil in pots to determine the influence of various kinds of dung upon the fertilizing effect of the nitrogren of nitrate of soda and urine are reported in detail. The results show that the dung contains microörganisms which rapidly destroy nitric and other available forms of nitrogen, so that it often happens that soils fertilized with such manure will produce less than unfertilized soil. The action of different kinds of dung in this respect is very variable. The reducing effect of horse dung was greatest and of sheep dung the smallest of the different kinds tested.

Experiments on white mustard in which nitrate of soda was applied at the same time with horse dung and 2 and 4 weeks after show that the reducing effect of the dung upon nitric nitrogen probably reaches the minimum in about 5 weeks, although it does not entirely disappear within 3 or 4 months.

The action of the different constituents of barnyard manure (urine, dung, and straw), alone and in mixtures, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 69–77*).—Cattle dung and urine and wheat straw separately and combined were compared, in pot experiments, with nitrate of soda and with no manure on oats, followed by white mustard grown on a sandy loam soil and on white mustard grown on a sandy soil. The data are tabulated and discussed at some length. The results clearly indicate that the addition of straw reduces the effectiveness of the manure, the injurious effect being greater the larger the amount of straw added. The use of excessive amounts of straw as litter is condemned on the ground that it not only lowers the effectiveness of the nitrogen of the manure, but also injuriously affects that of the soil and of other nitrogenous fertilizers that may be applied with it.

Tests on oats on sandy soil in 1894 and rye on loam in 1894–'95 led to the conclusion that the after effect of the difficultly soluble nitrogen of manure is comparatively very small.

Experiments on the fertilizing effect of phosphoric acid and nitrogen in peat and excrement mixture, and in poudrette, M. MAERCKER, H. STEFFEK, ET AL. (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 5–8*).—An account is given of 3 pot experiments with white mustard on sandy soil with 3 samples of peat and excrement mixture, 1 of which was acidified, and 3 samples of poudrette. The results show

that taking water-soluble phosphoric acid as 100, the effectiveness of the phosphoric acid in the peat and excrement mixture was 90.9 and in the poudrette 56.8. Analyses of the plants showed that if the amount of phosphoric acid assimilated in case of the soluble phosphoric acid be taken as 100, the amount assimilated in case of the mixture was 96.2 and in case of the poudrette 44.8. There was little difference in the fertilizing effect of nitrogen of the two kinds of manures. Taking nitrogen of nitrate of soda as 100, the effectiveness of the nitrogen of the mixture, in the light application was 62.2, in the heavy application 49.1; poudrette in the light application 54.1, in the heavy application 49. The after effect of the nitrogen was quite marked, and very nearly the same in each case.

Perchlorate as a cause of the injurious effect of nitrate of soda on rye, B. SJOLLEMA (*Chem. Ztg., 20 (1896), No. 101, pp. 1002, 1003*).—The injurious effect of nitrate of soda has been noted by a number of observers[1] and several explanations of it have been suggested, among others, that the injury was due to a deficiency of rainfall resulting in the soil solution of nitrate becoming too concentrated. The author observed, however, that of parallel plats of rye receiving different kinds of nitrate of soda some were seriously injured while others were not so affected, indicating that the injury was due to some constituent of the nitrate itself. A chemical examination of samples of nitrate which had been found to be very injurious to rye revealed the presence of considerable percentages of perchlorate, ranging from 0.94 to 6.79 per cent.

For the determination of perchlorates 100 gm. of the nitrate was dissolved in 500 cc. of water. In 50 cc. of this solution chlorin was directly determined by titration with silver solution, and a second aliquot of 50 cc. was evaporated to dryness, carefully ignited, dissolved in water, and the chlorin determined as in the first. The difference between the first and second determinations was taken to represent the chlorin due to perchlorates. Tests of the method on pure salts indicated that it gave quite accurate results, although there was danger of error due to volatilization of chlorin.

The results of analyses indicate that the perchlorate is in the form of potassium perchlorate. Tests of the effect of potassium and sodium perchlorate on the germination and upon the young plantlets of rye are also reported. The number of seeds germinating was not affected, but the growth of the plantlets was retarded and frequently altogether checked by small percentages of perchlorate. A one-half per cent solution was sufficiently strong to bring about this result. Pure nitrate also checked growth, but to a much less extent.

Pot experiments are reported, in which different amounts of potassium and sodium perchlorate, mixtures of sodium nitrate and potassium perchlorate, and pure sodium nitrate and commercial sodium nitrate containing perchlorates were applied to rye. The injurious effect of the

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[1] A. Stutzer, Deut. landw. Presse, 23 (1896), No. 66. p. 592 (E. S. R., 8, p. 391).

perchlorate was evident within a few weeks after the beginning of the experiments, although no such effect was observed where no nitrate or only pure nitrates were used. The maximum amount of perchlorate which can be applied to rye without injurious effect was not determined, but this is to be made the subject of further investigation.

Experiments with soluble, reverted, and insoluble phosphoric acid, E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 157–210*).—This is a continuation of experiments carried on since 1883 on 12 twentieth-acre plats (E. S. R., 3, p. 461). They "were made upon the ordinary four-course rotation of this section, viz, wheat, grass, corn, and oats, the fertilizers being applied to the wheat and corn, and were preceded by an unmanured oat crop upon all the plats in 1883 for the purpose of testing the uniformity of the soil."

The results are tabulated in detail and may be summarized as follows:

"*Wheat.*—Taking the average for the 3 years, 1884, 1888, and 1892, insoluble phosphoric acid in the form of ground bone, was first in the yield of grain and straw, insoluble phosphoric acid in the form of ground South Carolina rock second in grain and straw, no phosphoric acid third in grain and fifth in straw, reverted phosphoric acid in the form of dissolved boneblack treated with an equal weight of lime fourth in grain and third in straw, and soluble phosphoric acid in the form of dissolved boneblack fifth in grain and fourth in straw.

"*Grass.*—Taking the average for the 3 years, 1885, 1889, and 1893, insoluble phosphoric acid (ground bone) was first, reverted second, soluble third, and insoluble (South Carolina rock) fourth.

"*Corn.*—Taking the average for the 3 years, 1886, 1890, and 1894, insoluble phosphoric acid (ground bone) was first in the yield of grain and stover, reverted second in grain and third in stover, soluble third in grain and second in stover, and insoluble (South Carolina rock) fourth in grain and stover.

"*Oats.*—Taking the average for the 3 years, 1887, 1891, and 1895, insoluble phosphoric acid (ground bone) was first in the yield of grain and straw and weight per bushel, insoluble (South Carolina rock) second in grain and straw and fourth in weight per bushel, reverted third in grain, fourth in straw, and second in weight per bushel, no phosphoric acid fourth in grain and fifth in straw and weight per bushel, soluble fifth in grain and third in straw and weight per bushel."

The conclusions reached are as follows:

"(1) Soluble phosphoric acid is too expensive to be used by farmers having a limestone soil similar to the one on which this experiment was made, since fully as good results can be secured by the use of the much cheaper insoluble form.

"(2) Insoluble phosphoric acid in the form of ground bone is slightly superior to that in the form of South Carolina rock.

"(3) Corn is benefited more by the application of phosphoric acid than wheat, oats, or grass."

Experiments on the effectiveness of citrate-soluble phosphoric acid in Thomas slag, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 24–30*).—Thomas slags containing different amounts of citrate-soluble phosphoric acid were compared with water-soluble phosphoric acid on alfalfa and oats, followed by white mustard grown on sandy soil in pots. The results clearly indicate that the citrate solubility is a true index of the effectiveness of the phosphoric acid of the slag.

If the effectiveness of water-soluble phosphoric acid be taken as 100, that of the citrate-soluble phosphoric acid in case of alfalfa was 90.9 and in case of oats 82.4. The after effect of the slag on white mustard was much greater than that of the water-soluble phosphoric acid, being as 151.6:100. The after effect of the slag was greater the higher the percentage of citrate-soluble phosphoric acid which it contained.

Slags from which the citrate-soluble phosphoric acid had been removed were compared in the same manner. The effect on the first crop of oats was practically insignificant, but the after effect on the following crop of mustard was more marked, although much inferior to that of slags containing citrate-soluble phosphoric acid.

Thomas slag, in which 42.8 per cent of phosphoric acid was citrate soluble, was compared on alfalfa and oats, followed by mustard with the same slag so treated, by fusion with quartz, that 89.2 per cent of its phosphoric acid had been rendered citrate soluble. The results show clearly that not only the citrate solubility, but to an equal degree the fertilizing effect of the phosphoric acid had been increased by fusion with quartz.

The effectiveness of partially dissolved bone meal, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 22, 23*).—To steamed bone meal was added the amount of sulphuric acid which it was calculated would convert the phosphate into dicalcium phosphate. The preparation, however, contained 3.5 per cent of water-soluble phosphoric acid and 19.5 per cent of total phosphoric acid, a part of the phosphoric acid remaining in the tricalcium form. This material was compared with Thomas slag on oats, white mustard, and alfalfa, grown in pots on sandy soil. On the oats the 2 phosphates produced practically identical results. On mustard following oats the prepared bone meal was much more effective than the Thomas slag, although the amount of phosphoric acid utilized by the crop in each case was practically identical. In the case of alfalfa the prepared bone meal was slightly more effective in increasing the yield and was utilized to a much greater extent than the Thomas slag.

Vegetation experiments on the fertilizing effect of various potash salts, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 8–15*).—The fertilizing effect of kainit, carnallit, hartsalz (Schönit),[1] carbonate of potash, sodium chlorid, and magnesium chlorid, applied at rates of 445 and 890 lbs. per acre, was tested on alfalfa, white mustard, and potatoes, grown in pots containing light sandy soils.

In the case of alfalfa, kainit and carnallit produced about the same effect. The hartsalz gave a much larger increase in yield than the other Stassfurt potash salts used, although it proved inferior in this respect to the potassium carbonate.

[1] This is a salt similar to sylvinit, and contained potash, 14.91 per cent; lime, 3 per cent; magnesia, 6.62 per cent; sulphuric acid, 15.11 per cent; and chlorin, 39.33 per cent.

Experiments in which 445 lbs. of sodium carbonate per acre was applied indicated that a large part of the favorable effect of the potassium carbonate was due to its alkalinity. Sodium chlorid applied in amounts of 890 lbs. per acre proved poisonous; when applied in amounts of 445 lbs. it produced considerable increase in yield.

Magnesium chlorid applied at rates of 445 and 890 lbs. per acre not only decidedly increased the yield, but also increased the amount of potash taken up by the crop. The sodium chlorid did not produce the latter effect. Consequently the sodium salt may be considered to a certain extent as a conserver of potash, while the magnesium salt may be useful in rendering available the insoluble potash compounds of the soil.

In case of the mustard the results were much the same as with alfalfa, except that the use of sodium carbonate resulted in a decided decrease in yield, and the sodium and magnesium chlorids also proved injurious.

As regards the yield of potatoes, the hartsalz produced better results than kainit and carnallit, although the percentage of starch in the potatoes was larger in the case of kainit than with the other salts. The total amount of starch produced in case of the hartsalz and carnallit, however, was much greater than with the kainit.

Comparative tests were made of pure potassium chlorid and potassium sulphate. Both salts produced a larger yield than any of the Stassfurt salts, but the percentage of starch in the tubers was no higher. Potatoes fertilized with potassium chlorid contained 15.69 per cent of starch, while those fertilized with potassium sulphate contained 16.71 per cent.

Experiments with various potash salts on a mixture of grasses and leguminous plants (clover) on a light sandy soil, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 16–21*).—This is an account of a continuation of experiments begun in 1893. The potash salts used were kainit, carnallit, sylvinit, potash and magnesia sulphate, and a mixture of carnallit and potassium chlorid. These were applied at rates of 533.6 and 801.6 lbs. per acre, and proved about equally effective in increasing the yield. In each case the potash appeared to be largely exhausted by the first cutting. This was true in case of both the light and heavy applications. The excess of potash in case of the latter appeared to be utilized in the production of a luxuriant growth. The results indicate that it is a mistake to suppose that any considerable amount of the potash applied to one crop of hay is left in the soil for succeeding crops. In order, therefore, to get the best result applications of potash should be made each season.

Experiments on the influence of crude potash salts upon the consumption of water by plants, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 15, 16*).—Kainit, carnallit, and common salt applied at rates of 890 and 1,780 lbs. per acre were compared on white

mustard grown in pots. In one series of experiments the amount of water in the pots was kept constantly at 18 per cent (60 per cent of the total water capacity of the soil). Taking the water consumption of the plants on the soil without application of potash as 100, that on the soil receiving 890 lbs. of kainit per acre was 90.5; 1,780 lbs. of kainit, 88.4; 1,780 lbs. of carnallit, 91.9; 1,780 lbs. of common salt, 61.2. With 8 per cent of water in the soil (27 per cent of the total water capacity) the figures were as follows: Without potash, 100; with 890 lbs. of kainit, 77.1; 1,780 lbs. of kainit, 38.2; 1,780 lbs. of carnallit, 68.9; 1,780 lbs. of salt, 55.

It appears that the potash salts have a decided influence in conserving the moisture of the soil, which may be of great importance in a dry season.

The real value of Natural Plant Food, L. L. VAN SLYKE (*New York State Sta. Bul. 108, n. ser., pp. 225–230*).—"Chemical analysis at this station shows that the materials [composing this substance] are mostly in unavailable forms as plant food. An average of 3 samples shows the following composition: Total phosphoric acid, 22.21 per cent; insoluble phosphoric acid, 20.81 per cent; available phosphoric acid, 1.40 per cent; potash soluble in water, 0.13 per cent.

"Natural Plant Food is really a mixture of some rock phosphate (probably Florida soft phosphate) with glauconite, a mineral containing potash in an insoluble form, commonly known as 'green sand marl.'

"The selling price of Natural Plant Food varies usually from $25 to $28 a ton; its real agricultural value as plant food is probably below $10 a ton at a liberal estimate."

Analyses of commercial fertilizers, L. L. VAN SLYKE (*New York State Sta. Bul. 107, n.ser., pp. 163–223*).—This bulletin includes explanations of terms used in stating the results of analyses of fertilizers, notes on valuation, a comparison of selling prices and commercial valuations, a list of manufacturers complying with the provision of the fertilizer law, and analyses of 313 samples of fertilizers examined during the spring of 1896.

"Of the 313 different brands collected, 139 were below the manufacturer's guaranty-analysis in one or more constituents, in amounts varying from 0.03 to 4.41 per cent.

"The amount of nitrogen was below the guaranty-analysis of the manufacturer in 40 brands, the deficiency varying from 0.03 to 0.93 per cent and averaging 0.28 per cent. In 20 of the 40 brands, the deficiency was not greater than 0.25 per cent; in 14 brands, it was over 0.25 and below 0.50 per cent; in 6 brands, it was over 0.50 and below 1 per cent.

"The amount of phosphoric acid was below the manufacturer's guaranty-analysis in 84 brands, the deficiency varying from 0.04 to 4.41 per cent and averaging 0.77 per cent. In 26 of the 84 brands, the deficiency was less than 0.25 per cent; in 13 cases, it was above 0.25 and below 0.50 per cent; in 26 brands, it was above 0.50 and below 1 per cent; in 13 brands, the deficiency was above 1 and below 2 per cent; in 2 brands, it was above 2 and below 3 per cent; in 2 brands, it was above 3 and below 4 per cent; and in 2 brands, it was above 4 and below 5 per cent.

"The amount of potash was below the manufacturer's guaranty-analysis in 57 different brands, the deficiency varying from 0.04 to 2.91 per cent and averaging 0.56 per cent. In 21 of the 57 brands, the deficiency was below 0.25 per cent; in 13 brands, it was above 0.25 and below 0.50 per cent; in 13 brands, it was above 0.50 and below 1 per cent; in 9 brands, the deficiency was above 1 and below 2 per cent; and in 1 brand, it was above 2 and below 3 per cent.

"The retail selling price of the brands collected varied from $6 to $65 a ton, and

averaged $28.96. The retail cost of the separate ingredients unmixed was $23.37, or $5.59 less than the selling price."

Home-mixing of fertilizers, E. B. VOORHEES (*Amer. Agr.* (*middle ed.*), *59* (*1897*), *Feb. 13, p. 196*).

The fertilizing value of oil cakes, L. MALPEAUX (*Ann. Agron., 23* (*1897*), *No. 1, pp. 28–42*).

Observations on the injurious effects of concentrated mineral manures, KLEIN (*Ber. ü. Thätigk. Grossh. Bad. Landw. Bot. Versuchsanst., 1896; abs. in Ing. Agr., 7, No. 6, p. 242*).

Industrial by-products used as fertilizers, A. LARBALÉTRIER (*Les résidus industriels employés comme engrais. Paris: Masson et Cie., pp. 160*).

A phosphate deposit in Juniata County, Pennsylvania (*Pennsylvania Sta. Rpt. 1895, pp. 136–147, pl. 1, fig. 1*).—A reprint of Bulletin 34 of the station (E. S. R., 8, p. 37).

Potassium and ammonium carnallits containing bromin, A. DE SCHULTEN (*Bul. Soc. Chim. Paris, 17–18* (*1897*), *No. 3, pp. 167–169*).

Why should Thomas slag be purchased on guaranty of its citrate solubility? B. TACKE (*Landw. Wochenbl. Schles. Holst., 47* (*1897*), *No. 4, pp. 67–70*).

Experiments on the fertilizing effect of nitrogen of bone meal and of strontium solution, M. MAERCKER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 21, 22*).—A brief report is given of comparative tests of bone meal and strontium solution, a by-product obtained in the purification of sugar-beet juice. Taking the fertilizing effect of nitrate of soda as 100, that of the bone meal was 64 to 67.9, and of the strontium solution 90.8 to 95.3.

Composition of wood ashes sold in Pennsylvania, W. FREAR (*Pennsylvania Sta. Rpt. 1895, pp. 224–226*).—Analyses of 15 samples of ashes are tabulated and discussed.

Analysis of commercial fertilizers, W. C. STUBBS (*Louisiana Stas. Bul. 45, 2d ser., pp. 56–80*).—This includes the text of the State fertilizer law, a discussion of the character of the fertilizers sold in Southern markets and of those adapted to Louisiana soils, a list of guarantied analyses, notes on valuation, and tabulated analyses of 96 samples of fertilizing materials, including acid phosphate, bone, tankage, cotton-seed meal, dried blood, and mixed fertilizers.

A discussion of certain commercial articles: Fertilizers, W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 132–135*).—A reprint of Bulletin 19 of the station (E. S. R., 7, p. 111).

Inspection of fertilizers in Maine, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Rpt. 1895, pp. 131–132*).—A reprint from Bulletin 18 of the station (E. S. R., 7, p. 111).

Inspection of fertilizers, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Rpt. 1895, pp. 142–146*).—A reprint of Bulletin 22 of the station (E. S. R., 7, p. 940), and text of the State fertilizer law.

Analyses of fertilizers, C. A. GOESSMANN (*Massachusetts Hatch Sta. Bul. 42, pp. 31*).—The text of the State fertilizer law approved April 17, 1896, is given, with tabulated analyses of 153 samples of fertilizing materials, including ashes, muck, barnyard manure, bone, kainit, sulphate of potash, muriate of potash, double manure salt, nitrate of soda, sulphate of ammonia, dried blood, tankage, dissolved boneblack, acid phosphate, and mixed fertilizers.

The new law differs from that passed in 1888 mainly in providing for the inspection of all fertilizing materials—not excepting those which are sold for less than $10 per ton, in requiring that not only in the case of the use of leather but also of hair and wool wastes in fertilizers a statement of such use shall be affixed to each package, and in making the director of the Hatch Experiment Station responsible for the execution of the law.

Miscellaneous fertilizing substances, W. FREAR (*Pennsylvania Sta. Rpt. 1895, pp. 227–236*).—Analyses of 4 samples of tan-bark ashes, 1 of "fleshings" from hides,

1 of tannery scutch, 1 of refuse lime, 3 of paper mill wastes, 1 of marl, 1 of gypsum, 1 each of blast furnace cinder and soot, 3 of muriate of potash, 4 of cotton-seed meal, 2 of spoiled gluten meal, 2 of Natural Plant Food, and 1 each of tobacco stems and suckers are tabulated and discussed.

Analyses of commercial fertilizers, H. J. WHEELER, B. L. HARTWELL, and C. L. SARGENT (*Rhode Island Sta. Bul. 40, pp. 71-79*).—Analyses and valuations of 60 samples of fertilizers are tabulated.

FIELD CROPS.

Alfalfa, W. P. HEADDEN (*Colorado Sta. Bul. 35, pp. 3-95, pls. 18*).—This is a comprehensive bulletin on the alfalfa plant, its culture, composition, structure, fertilizing value, vitality of seed, etc.

Notes are given upon the history, description, culture, and varietal differences of alfalfa. The author found very little difference between 3 French varieties grown at the station, but a variety from Turkestan was distinct in habit and very uniform, growing erect with leafy and numerous stems.

Analyses were made of samples of the whole plant in different stages of growth, of alfalfa hay, and of parts of the plant.

The principal data are shown in the following table:

Composition of alfalfa.

Number.	Number of cutting.		Water.	In air-dry material.						
				Moisture.	Crude protein.	Amid nitrogen.	Ether extract.	Nitrogen-free extract.	Crude fiber.	Ash.
		Whole plant:	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1	1	Very immature	74.79	4.85	21.79	......	......	......	[1]22.56	12.16
2	1	.....do	72.74	5.15	19.95	......	......	......	[1]29.79	10.64
3	1	Not in bloom	70.90	4.17	15.60	0.284	1.94	32.91	35.17	10.21
4	1	Not in bloom, different locality from preceding	72.65	7.86	14.30	.187	1.52	29.79	37.39	9.14
5	1	Half bloom	73.06	6.04	14.41	.372	1.19	32.50	36.54	9.30
6	1	Full bloom, without irrigation	73.61	4.49	13.95	.176	2.20	37.64	32.48	9.24
7	1	Full bloom, low land	74.06	6.30	14.08	230	1.13	27.85	40.18	10.46
8[2]	1	Full bloom, high land	73.22	7.14	14.54	......	1.40	30.59	36.39	9.94
9[2]	1	.....do	73.67	7.46	14.83	......	1.54	33.24	32.27	10.19
10[2]	1	.....do	71.45	3.77	15.22	......	1.40	33.11	35.51	10.99
11[2]	1	.....do	74.39	7.60	15.92	......	1.67	31.41	31.96	11.34
12	1	Just past full bloom	......	8.87	14.54	......	1.40	30.59	36.39	9.94
13	1	In full seed	......	4.70	12.16	......	1.03	29.22	46.12	6.77
1	2	Not in bloom, without irrigation	71.52	6.48	16.40	......	1.46	36.49	28.66	10.51
2	2	Coming into bloom, upland	74.35	4.40	18.47	.517	1.14	31.58	32.46	11.95
3	2	Half bloom	68.65	6.61	16.11	.350	1.18	28.90	37.24	9.91
4	2	.....do	70.40	5.29	13.03	.614	1.52	33.29	37.39	9.48
5	2	Full bloom	74.50	4.31	12.88	.202	1.76	32.02	38.06	10.97
6	2	Half ripe, upland, with irrigation	62.91	7.24	12.08	......	1.99	38.79	30.99	8.92
1	3	Hay, College Farm	......	5.78	12.53	.100	1.61	31.35	39.35	9.38
2	3	Hay, Rocky Ford Station	......	6.08	13.57	......	1.31	34.09	34.67	10.28
		Leaves, early bloom, with irrigation	......	4.93	23.33	......	2.96	41.16	13.15	14.48
		.....do	......	4.63	24.33	......	2.94	40.70	13.12	14.29
		Leaves, early bloom, without irrigation	......	8.40	22.18	......	4.10	41.05	10.67	13.60
		.....do	......	8.53	22.60	......	3.43	41.45	10.66	13.35
		Leaves, half bloom, without irrigation	......	8.62	22.30	......	4.28	40.90	12.48	11.39
		.....do	......	8.38	23.31	......	4.28	40.60	12.48	11.39
		Leaves, past full bloom	......	4.49	20.20	......	2.88	41.77	16.16	14.50
		.....do	......	4.52	20.20	......	3.05	41.72	16.00	14.51
		Stems	......	5.41	6.31	.070	.94	28.03	54.40	4.91
		Flowers	......	4.46	21.33	.692	2.11	42.77	19.92	9.41
		Seed	......	6.35	29.26	......	14.41	37.04	9.35	3.19

[1] Not included in average.
[2] Samples 8, 9, 10, and 11 grown in drills.

The average percentage of protein in the samples from the first cutting was 14.85, but excluding the immature samples cut May 5, 13.98; from second cutting 14.43, and from third cutting 13.05. Samples taken from the ordinary farm crop showed similar relations, the averages being 14.92, 13.99, and 13.47 for the 3 cuttings.

"Judging by the amounts of proteids in the 3 different cuttings, the first and second cuttings stand very close to each other in value with the difference in favor of the first cutting. In the farm samples, . . . the first cutting is materially the best of the 3. I would here remind the feeder who prefers the second or even the third crop for certain feeding that the amount of proteids present is not the only measure of good hay. Not only is the quantity of proteids greater in the first cutting, but the yield is also greater and the hay cut just at the beginning of bloom is richer in this constituent than when cut later. From beginning bloom to half bloom the amount of proteids seems to be nearly stationary and the crop is also probably at its maximum. . . .

"If the plant continues to store up organic matter after this period is past, I am inclined to think that the loss by the dropping of leaves, due to the maturing of the plant and the action of the fungus common on our alfalfa, more than compensates for the gain. . . . If the very early cutting be rejected from the series . . . it changes the results in favor of the second cutting. . . .

"[The results] show an increase in the crude fiber as the plant matures, but there is a considerable variation in the samples, with a few apparent contradictions, which is to be explained by differences under which the samples were grown and taken. . . . From the beginning of bloom to half bloom the increase is not very rapid and the averages obtained for the hays of different cuttings are nearly equal, at least not so far apart as public judgment assumes; for the first, 35.21 per cent; for the second, 34.15 per cent (laboratory sample), 34.47 per cent (farm sample); and for the third cutting, 37.01 per cent."

A comparison was made between alfalfa hay exposed to warm, sultry weather for 15 days after cutting, during which time 1.76 in. of rain fell in 3 showers, and hay from the same field cut the same day but immediately dried in an air bath. The results appear in the table below:

Comparison of alfalfa hay cured with and without being rained on.

	Ash.	Crude fiber.	Crude fat.	Crude protein.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay cured in an air bath	12.18	26.46	3.94	18.71	38.71
Hay exposed to rain	12.71	38.83	3.81	11.01	33.64

The author believes such damaged hay to be worth about one-half as much as good hay, the damage being due to mechanical losses and loss of "general qualities recognized as essential to good hay," as well as to loss of proteids and nitrogen-free extract.

Comparative analyses are also tabulated of alfalfa and clover hay, and of silage made from alfalfa, from clover, and from pea vines.

Ash analyses of the plant and its parts are tabulated, and the amounts of fertilizing ingredients removed by a ton of alfalfa hay at each of the 3 cuttings and by a ton of red clover are calculated. The latter data are shown on page 770.

Fertilizing ingredients removed by 1 ton of alfalfa or red clover.

	Nitrogen.	Phosphoric acid.	Potash.	Sulphuric acid.	Chlorin.	Lime.	Magnesia.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
First cutting	46.00	8.69	51.46	8.97	13.95	46.40	7.54
Second cutting	48.13	9.32	51.99	13.06	19.75	56.74	8.17
Third cutting	37.90	6.79	49.39	6.17	8.16	37.39	7.21
Average for alfalfa hay	44.01	8.27	50.95	9.40	13.95	43.51	7.64
Alfalfa in full seed	38.92	6.95	35.97	5.41	9.70	25.87	5.73
Red clover, heads half turned	42.98	7.32	50.32	2.52	5.15	47.56	10.45

The author considers an average crop to be 1.65 tons at first cutting, 1.2 tons at second cutting, and 1 ton for third cutting.

Quite an extended discussion is given on the amount of seed required per acre, the question of a "good stand," and the vitality of alfalfa seed. Samples of prime seed of different ages, and of screenings of first, second, and third quality and of different ages were tested for vitality, with the following average results:

Germination of alfalfa seed.

Quality.	Age of seed.	Number of seeds to the pound.	Average percentage— Rotted.	Left.	Sprouted.
	Years.				
Prime seed[1]	2	214,559	1.12	6.0	92.88
Do	3			1.5	98.50
Do	6		5.00	2.0	93.00
Screenings, first quality	1	259,340	21.50	12.0	66.50
Do	2	344,123	35.50	9.0	55.00
Do	3	266,233	20.00	1.0	79.00
Screenings, second quality	2	331,383	56.00	6.0	38.00
Screenings, third quality	1	312,385	57.00	3.0	40.00

[1] Average of 4 samples.

"The hard seed remaining at the end of the sprouting tests were put together and the test continued for an additional 20 days, when 78 per cent of them had sprouted, 13 per cent rotted, and 9 per cent were still left. This explains, in part at least, the observations that some alfalfa seed seems to lie dormant for a time. . . . The results are positive in showing that the age of the seed up to 6 years old does not affect its germinating power. . . .

"These tests and observations also strengthen the claim made that in practice screenings produce as satisfactory results as prime seed. Taking it on the basis of the germinating power in the most unfavorable sample, second quality screenings 2 years old, with only 38 per cent germinating, we have, where 20 lbs. of seed are sown to the acre, 1,325,532 plants; and assuming that one-seventh of them live, there would be 189,361 plants to the acre, or over 4 to the square foot, a sufficient number, surely, to produce a maximum crop."

The author found the tap roots of alfalfa to be smaller than is usually supposed, being under rather than over 0.5 in. in diameter, though anomalous types were found which were short and as much as 2.8 in. in diameter. The root system, which is illustrated by plates, is simple, consisting of a single tap root extending down from 3 to 5 ft. and then dividing into a few branch roots, which usually deviate only a few inches from the course pursued by the tap root before division. In no

case has the author found "a system of small roots starting out below and near the crown, extending laterally for several feet and then turning downward, forming a symmetrical conical system, whose broadest part was near the surface." The depth to which the roots penetrate differs with the soil and with the height of the permanent water table. The greatest observed depth was 12.25 ft. in a homogeneous clay. No apparent relation was discovered between the age and the size or the death rate of the roots.

Tubercles appear on the roots in 3 forms, as warty excrescences near the neck, and as single and colonized nodules on the roots. The excrescences only appear at shallow depths, the colonies at from 3 to 5 ft., and the single nodules at all depths. These nodules were found to differ greatly in abundance on roots of plants in different localities, though the plants appeared of equal vigor and the proteids in the hay varied little. Compared with vetches and red clover, alfalfa is poorly supplied with nodules, but the groups are much larger, frequently being 1.5 in. in diameter. Some of these groups were analyzed and found to contain 5.725 per cent of nitrogen, while the cortex of the roots contained only 2.25 per cent.

The author believes that the total weight of roots equals or exceeds that of the tops. The amount of the roots within reach of the plow, added to the amount of stubble left by the first mowing, is two-thirds the weight of green alfalfa removed.

A full discussion is given of the manurial value of the stubble and roots, with calculated amounts of constituents and of ash ingredients in 1,000 lbs., and analyses of soils on which 2 samples were grown and of ground water and seepage water in one instance.

The author believes it safe to assume that 1 ton of leaves, broken stems, etc., is lost in the making of every 5 tons of hay, and that there is thus returned to the soil annually the equivalents of 25.79 lbs. of calcium phosphate, 77.73 lbs. potassium chlorid, and 449 lbs. of sodium nitrate. In addition to this, the principal fertilizing ingredients in the stubble and roots have an estimated value of $35 per acre, and the author thinks the easily decaying alfalfa roots possess a high value as increasers of the humus in prairie soils.

In an appendix the methods used in making the analyses are discussed, and the analyses of alfalfa are compiled.

Cañaigre, R. H. FORBES (*Arizona Sta. Bul. 21, pp. 35, figs. 6*).—Previous work in this line was published in Bulletin 7 of the station (E. S. R., 4, p. 804). In studying the formation of tanning materials 36 lots of 25 one-year-old roots, weighing nearly 2 lbs. per lot, and as uniform as possible, were planted November 26 and closely observed for 10 months. All were irrigated 4 times and 3 lots 3 times in addition. Samples were dug for analysis each week during the growing season, and at intervals throughout the summer. The results are tabulated. The author states that the tanning materials remain quite constant throughout the whole growing season.

In samples of wild roots analyzed, comprising every age up to 5 years, "it was found that the average increase of tanning material from year to year in 10 instances was 1.64 per cent (in water-free material)." Irrigation apparently did not lessen the percentage of tanning materials. During the year in roots from different localities the percentage of tanning materials varied from 18.17 to 32.56 per cent. Heat, air, and fermentation all cause loss of tanning materials. Analyses are given of cañaigre bagasse (food constituents) and of cañaigre ash (fertilizer constituents). "Ton for ton [compared with sugar beets] cañaigre demands 3 times as much nitrogen and draws 1½ times as heavily on potash and phosphoric acid."

In his summary the author states that cañaigre is best adapted to the mild, dry, sunny winter climate of the Southwest; that the plant is not known to be seriously threatened by insects; that it draws heavily upon the soil, especially for nitrogen, and that an annual crop of 7 tons or a biennial crop of 13 tons is required in order to equal the profit of sugar-beet culture.

Cānaigre, the new tanning plant, H. H. HARRINGTON and D. ADRIANCE (*Texas Sta. Bul. 38, pp. 789–797, pls. 7*).—This bulletin gives a description of the plant, notes on its propagation, planting, methods and cost of raising, harvesting, drying, and extracting. This information is based upon commercial experience in the State and in Arizona, New Mexico, and California. A large number of analyses of cānaigre at different stages of growth and from different localities are given, together with analyses of cānaigre roots at from 1 to 17 months old. The method of analysis used and some trials upon the time of extraction are given. The authors assume that 10 tons of roots to the acre can be raised. Allowing \$3 per ton for the cost of growing and \$5 per ton for the selling price, this gives a profit of \$20 per acre.

The following conclusions are given:

"(1) The crop seems particularly adapted to west and south Texas, but may be profitable in north and east Texas.

"(2) It can not be readily adopted by the farmer of limited means, but on the coöperative plan is almost sure to give good returns.

"(3) While the root continues to increase in tannic acid for some time, it will pay best to gather when a year, or a season, old.

"(4) Freezing does not seem to injure the tannin in the root.

"(5) Our results indicate a demand for potash as a fertilizer, but this would vary with the soil.

"(6) Cultivation increases the tannin, gives a root better in color and appearance.

"(7) The tannin of cānaigre is adapted for tanning the finest grades of leather, giving a leather of fine finish, color, and durability.

"(8) A low temperature—preferably 120 or 130°—is best for drying the sliced chips."

Experiments in corn culture, 1896, G. E. MORROW and J. H. BONE (*Oklahoma Sta. Bul. 21, pp. 3–12*).—The corn was grown at the station upon upland prairie soil of average fertility, the season being quite favorable except for excessive rainfall in mid season. The experiments

consisted of tests of 37 varieties and comparisons of crops on plats planted at different rates with lister and with planter; and on plats cultivated either deep or shallow and with varying frequency.

Tabulated data and discussions are given for each test. The results are briefly as follows: The best yields were from medium-sized varieties which had been grown in the vicinity or in southern Kansas for some years. The 6 plats drilled with the ordinary planter gave a yield 14 per cent greater than that of the listed plats; and of the drilled plats, that planted March 28 was best.

With both medium and small eared varieties thicker planting than usual gave the best results, the largest yields of both corn and stover with the larger variety being from the plat planted with 3 kernels every 24 in. in 3-foot rows; and with the smaller variety from 2 kernels each 9 in.

The average yield of the 4 plats given shallow cultivation was 18 per cent greater than of the 3 plats given deep cultivation. Cultivation of plats 3 times a week gave slightly larger yields than did weekly cultivation, but the increase was not equal to the extra cost.

Determinations of moisture in corn grown in these tests and harvested and sampled at different dates were made. Corn husked from standing stalks averaged 23 per cent, and that from stalks cut August 1 and sampled September 12 averaged 12.5 per cent. When well dried, 68 lbs. of ear corn of any of the better varieties gave 56 lbs. of shelled corn.

The profitable amount of seed per acre for corn, W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 19, 20*).—This is in continuation of experiments described in the Annual Report of the station for 1894 (E. S. R., 7, p. 856). In 1895 an acre tract of land received an application of 10 two-horse loads of barnyard manure and 750 lbs. of commercial fertilizer, and was divided into 4 duplicate series of 3 plats each. In each series plats were planted with kernels 6, 9, and 12 in. apart. The corn was cut for silage and samples analyzed. Tables show the composition of the crop of 1895, and yields of 1894 and 1895.

"The results so far reached indicate that the amount of seed may vary greatly without materially affecting the yield of dry matter in the mature crop. The average yield per acre of dry matter for the 2 seasons, with the several rates of seeding, are as follows: Kernels 6 in. apart, 5,246 lbs.; 9 in., 5,390 lbs.; 12 in., 4,848 lbs.

"There appears so far to be only a small difference between 6 in. and 9 in. seeding, whereas the yield from the 12 in. was materially smaller both years.

"It should be noted that the corn from the 9 in. and 12 in. seeding was eared more satisfactorily than that from the 6 in."

White or yellow varieties of corn, E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 111, 112*).—The results derived from a compilation of analyses of white and yellow varieties of corn are given. The author concludes that the difference does not in any case exceed $\frac{1}{4}$ per cent, and that the composition does not vary enough to be of any significance.

A report on the culture of hemp and jute in the United States, C. R. Dodge (*U. S. Dept. Agr., Fiber Investigations Rpt. 8, pp. 43, pls. 3, figs. 4*).—The author says:

"The demand during the past 2 years for information regarding the best practices for the successful growth of hemp and jute in the United States, as well as the importance of including the accounts of the cultivation of these textiles in the Fiber series of Department publications, make the preparation of this report imperative. Hemp is already produced in limited quantities in portions of our country, but its cultivation should be extended. Jute is not produced within our borders. It is a plant of easy growth, however, and if the fiber can be produced to compete with the India product, such an industry would bring to the South a portion, at least, of the many millions of dollars now paid out annually for the imported article."

The following points relative to hemp are discussed: History of the plant and range of culture; statistics of production in the United States; cultivation, harvesting, and preparing the fiber; recent experiments in the South; experiments in California; and the uses of hemp.

Introductory remarks to the section on jute note the present demand by manufacturers in this country for Indian jute, and emphasize the perfect adaptation of the crop to cultural conditions of the southern section of the United States and its large yield of fiber. The other topics discussed are history of the industry; the different kinds of jute; the fiber and its uses; culture in India; culture in the United States; extraction of the fiber, including a discussion of the machine question; and value of the crop.

"[The author hopes] that careful experiments in this culture will be attempted and efforts made to extract the fiber, in order that the question of economical production of jute in the United States may be practically settled. Past experimentation has demonstrated that the plants will grow luxuriantly in many portions of the South, and that the bark contains a fine quality of fiber. To ascertain the cost of growing the crop and extracting and baling the fiber ready for the market is the only problem to be worked out."

The renewing of worn-out native prairie pastures, T. A. Williams (*U. S. Dept. Agr., Division of Agrostology Circ. 4, pp. 4*).—The author ascribes the frequent worn-out and weedy appearance of prairie pastures to drought and overstocking. The latter should be avoided, the cattle being fed green corn, sorghum, or other soiling crops when the pasture is becoming scant. By a few weeks' care the loss of the pasture for one or two seasons may be prevented.

Cultivation improves the more desirable native grasses, and a thorough harrowing to break up the soil crust and let in light and air and water will frequently be all that is needed to enable the better grasses to crowd out the weeds and restore the pasture. A moderate application of fine, well-rotted manure is an excellent restorative. When spots of the pasture have been killed out it is advisable to sow in them seeds of some of the tame grasses, though the author thinks it hardly possible in this way to make over a native pasture into a tame one. Kentucky blue grass, sheep's fescue, red fescue, and Canadian blue grass can be used to advantage on upland spots, and timothy, fowl meadow grass, red top, meadow fescue, and alsike on lowland.

Influence of chemical fertilizers on the product of natural and artificial meadows, E. ZACHAREWICZ (*Prog. Agr. et Vit., 26 (1896), No. 51, pp. 693–701*).—A general discussion is given of the principles of fertilizer application with special reference to conditions existing in mowing lands. Notes are given upon the work of Lawes and Gilbert and of Garola along this line; and experiments made under the author's supervision upon 2 private estates during the years 1894, 1895, and 1896 are reported. On one estate stable manure, a complete chemical fertilizer (including plaster), superphosphate, and liquid manure were applied for 3 years upon 4 tenth-hectare plats of land which had been in natural meadow for 9 years. Tables are given showing the weight of hay obtained at each of 3 cuttings and the financial value and profit for the crop of each year. The results are calculated for yields per hectare, and the financial statements are based upon hay at $1.35 per 100 kg. The average results for the 3 years are shown in the following table:

Comparative effect of fertilizers upon hay crop.

Fertilizer.	Cost of fertilizer.	Weight of crop.	Net value of crop.	Gain or loss (—) over check plat.
		Kg.		
Stable manure	$38.60	10,421	$102.18	$18.78
Complete chemical fertilizer	21.46	10,996	127.10	43.70
Superphosphate	7.23	9,118	115.81	32.41
Liquid manure	19.30	7,217	78.19	—5.21
None		6,171	83.40	

A 2-year test of the effect of a complete fertilizer including plaster as compared with no fertilizer was made upon land which had been in meadow for 30 years. The average yields per hectare are for the unmanured plat 9,662 kg., for the manured plat 12,816 kg., a difference in favor of the fertilizer of 3,154 kg., and a net gain, at the same price for hay as in the preceding experiment, of $19.64 per hectare.

A similar test upon alfalfa gave a profit of $21.81 per hectare from the use of a mixed mineral fertilizer containing no nitrogen.

Oats, test of varieties (*Pennsylvania Sta. Rpt. 1895, pp. 240, 241*).—Nineteen varieties of oats were grown in duplicate twentieth-acre plats. The oats were sown with a drill April 17 and 19 at the rate of 2 bu. per acre. The yields of grain and straw for 1895 of 19 varieties and the average for 6 years of 15 varieties are tabulated. In 1895 the largest yields were given by Jaune des Flanders, Improved American, German, Early Russian, Scottish Chief, and Henderson Clydesdale; the largest average yields for the 6 years were given by Japan, Improved American, Baltic White, German, and Scottish Chief.

A chemical study of the Irish potato, T. L. WATSON (*Virginia Sta. Buls. 55, pp. 99–113; 56, pp. 117–144*).—The analyses were of the crops of 1890 and 1892, the aim being to compare northern and southern-grown varieties. The data discussed and shown in tables relate to the water, dry matter, specific gravity, and starch content of 12 varieties grown in Virginia, 7 in Connecticut, and 3 in Michigan, analyzed

in 1891; and of 8 grown in Virginia, 4 in Connecticut, 7 in Michigan, 10 in New York, and 4 in Kansas, analyzed in 1893; the dry matter other than starch of 4 varieties grown in Virginia, 3 in Connecticut, and 3 in Michigan, crops of both years, and the ash constituents of varieties analyzed in 1893. In the second bulletin comparisons of these data are made for the several States and for different sections; maxima and minima and averages of ingredients in all varieties from the several States are given, and additional ash analyses tabulated of 20 varieties grown in 1893 in other States.

"The data accumulated are yet insufficient to make very positive statements, inasmuch as it will require the cultivation of the tuber in the several States under as nearly the same conditions as possible, with the study of the soil from a mechanical and chemical standpoint, and also a continuation of the work through a series of years before definite conclusions can be reached."

The following table shows the variation which may exist in the same variety grown in different parts of the same State:

Variation in the same variety of potatoes grown in different parts of Michigan in 1893.

Variety.	Water.	Dry matter.	Starch.	Specific gravity.
	Per cent.	*Per cent.*	*Per cent.*	
Early Rose grown at Lansing	81.05	18.95	12.38	1.070
Early Rose grown at Grand Rapids	79.19	20.81	15.31	1.086
Average	80.12	19.88	13.89	1.078
Beauty of Hebron	78.82	21.18	14.00	1.071
Do	81.65	18.35	14.67	1.084
Average	80.24	19.76	14.34	1.078

From the tabulated starch content of the varieties from different States it appears that the Kansas-grown sample of Triumph contained but 8.15 per cent, while Beauty of Hebron from Massachusetts contained 20.89 per cent, and that Dakota Red grown in Virginia contained 9.75 per cent, while grown in Canada it contained 14.29 per cent. The averages for the several varieties including compiled analyses from Kentucky, Colorado, and Canada are: Beauty of Hebron 17.13 per cent, Charles Downing 16.32, Pearl of Savoy 16.05, Climax 15.59, Early Rose 15.40, Green Mountain 15.24, Early Ohio 15.03, Burbank 14.69, Sunrise 14.54, Minister 14.26, Triumph 13.96, and Dakota Red 12.40.

So far as the author's work has gone he believes the following conclusions may be drawn:

"(1) The ratio . . . existing between the specific gravity and starch is not a fixed one. . . . Connecticut shows a lower specific gravity and a higher percentage of starch by about 2 per cent than the Virginia-grown varieties.

"(2) The value of the potato . . . based upon the amount of starch contained is very nearly the same . . . for the 3 districts, northern, western, and southern. The difference is slightly in favor of the northern-grown varieties, the southern varieties being slightly more valuable than the western.

"(3) The starch content varies for variety and locality.

"(4) Some varieties require more plant food than others, other conditions being the same."

Potatoes, test of varieties, E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 241–243*).—Twenty-three varieties of potatoes were tested on plats manured with 18 tons of barnyard manure per acre. No seed tubers were planted whole. The yields for 1895 and the averages for 2 years are tabulated. The largest yields were given by New Bovee Seedling, Early Everett, New Queen, Freeman, Pennsylvania Best, and Carman No. 1.

Experiments with nitrate of soda and nitrate of potash upon sugar beets, with notes upon top-dressing, SCHNEIDEWIND and MÜLLER (*Jahrb. agr. chem. Vers. Stat. Halle, 1895, pp. 31, 32*).—Experiments on sugar beets continued for 2 years indicated that nitrate of soda exerted a more favorable influence than nitrate of potash in years of short vegetative period, but that the difference disappeared in seasons of longer vegetative growth. The authors believe this to indicate that the sodium salt is a quicker acting fertilizer than the potash salt, which they attribute to the better solubility and diffusibility of sodium nitrate.

When part of the nitrate was applied as a top-dressing 68 per cent of the nitrogen was utilized, but when it was all applied before seeding only 42.5 per cent was used. The sugar content of the beets remained the same under both methods of application, but the ash content was slightly increased by the top-dressing.

The burning qualities of tobacco, J. NESSLER (*Jour. Landw., 44 (1896), No. 4, pp. 357–362*).—A reply to a criticism by A. Scerhati[1] of a former article by the author.[2] The latter maintains the correctness of his earlier conclusions and gives the following in addition:

(1) Every one-sided manuring with chemicals, as with sulphate of ammonia, nitrate of soda, or potash salts, is injurious to the quality of tobacco.

(2) In soils rich in phosphoric acid application of phosphates is not only useless but sometimes harmful.

(3) Barnyard manure lightens the soil, retains moisture, and contains materials which gradually become soluble and afford a lasting and regular supply of nutrients for the use of the plant. The quality of tobacco depends primarily upon the regular development of the plant, so that barnyard manure can not be replaced by rich but more slowly acting fertilizers, such as peat. Under otherwise similar conditions, the best tobacco will usually be obtained from a soil enriched by abundant, regular applications of barnyard manure.

Wheat, test of varieties, E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 237–240*).—Forty-eight varieties were grown on thirtieth-acre plats. The yields of grain and straw for 1895 and the average of 26 varieties for 6 years are tabulated. The 6 varieties giving the highest yields in 1895 were Mealy, Reliable, Royal Australian, Miami Valley, American Bronze, and Jones Square Head; in the average for 6 years Reliable,

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[1] Jour. Landw., 43 (1895), No. 4, p. 379 (E. S. R., 7, p. 950).

[2] Landw. Vers. Stat., 40, p. 395 (E. S. R., 4, p. 302).

Fulcaster, Valley, Ontario Wonder, Wyandotte Red, Dietz Longberry Red, and Currell Prolific.

Effect of fertilizers on the proportion of grain to straw and stover, H. J. WATERS and E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 220-223*).—A table is given showing the ratio of grain to stover and to straw in crops of corn, oats, and wheat grown in rotation for 12 years (1883-'94) with different combinations and amounts of fertilizers. The most important of the authors' conclusions are as follows:

"The largest amount of stover (stalks without ears) in proportion to the ears produced, was derived from the plats on which complete commercial fertilizer was used. . . . Less excess of stover over grain is returned by the barnyard manure plats than from those receiving a complete commercial fertilizer, the difference amounting to about 19 per cent.

"In the case of oats the reverse is true. The largest relative yield of straw is from the barnyard-manure plats, which show about 10 per cent more in proportion to the grain than do the complete chemical manures.

"Sulphate of ammonia shows a heavier yield of straw than does either nitrate of soda or dried blood.

"Averaging the yields from all sources of nitrogen, excepting in the yard manure, a slight increase in the straw yield is shown as the amount of nitrogen applied increases.

"With wheat the largest relative yield of straw is obtained from the plats receiving the complete commercial fertilizers. The proportionate yield of straw increases as the amount of nitrogen used increases."

General fertilizer experiments, H. J. WATERS and E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 211-219*).—This is a continuation of work upon the 4-year rotation of corn, oats, wheat, and grass.

A summary of 3 complete rotations was given in the Annual Report of the station for 1894 (E. S. R., 7, p. 943). The experiment was continued in 1895 according to the original plan, and tables are given showing the yield per acre of the different plats and the effect of different combinations and different amounts of fertilizers. Notes are given upon the crops but no conclusions are drawn.

Sunflower heads and blackeye peas as silage crops, J. M. BARTLETT (*Maine Sta. Rpt. 1895, pp. 21-23*).—These crops were grown and ensiled in the proportions of 0.25 acre of sunflowers and 0.5 acre of peas to 1 acre of corn. The peas were affected with mildew so the yield was rather light. The sunflowers were grown upon land prepared as for corn, the seed being planted 1 ft. apart, in drills 3.5 ft. apart. The expense of raising the crop is about the same as for corn.

The following table shows the yield per acre and percentage composition of the air-dry material in the sunflower heads and peas:

Yield and composition of sunflower heads and blackeye peas.

	Yield per acre.			Composition of air-dry substance.					
	Fresh.	Air-dry.	Water-free	Water.	Protein.	Crude fat.	Nitrogen-free extract.	Fiber.	Ash.
	Lbs.	*Lbs.*	*Lbs.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*	*Per ct.*
Sunflower heads	12,720	2,200	2,040	7.27	12.63	14.41	34.56	24.4	6.73
Peas, whole plant	13,380	2,013	1,861	7.57	17.19	2.61	35.18	30.0	7.45

Data are also tabulated for percentage composition of fresh plants and water-free substance, and nutrients per acre and per ton are compared with other fodders.

The author gives the following summary:

"So far as is indicated by this experiment it would seem that sunflowers are not nearly as profitable a crop to raise as corn. With the same cultivation corn produces a third more protein and nearly twice as much carbohydrate material as sunflower heads.

"When compared with our common red clover an average crop of the latter plant produces nearly twice as much protein and more carbohydrate matter per acre. From this very limited experience we are not favorably impressed with the sunflower as a profitable silage crop. The peas are not considered, as a fair average crop was not secured."

Autumn catch crops, P. P. DEHÉRAIN (*Ann. Agron., 22 (1896), No. 12, pp. 545–551*).—The requirements of a good autumn catch crop and the adaptability of a number of plants to this purpose are discussed. Experiments were made at Grignon in vegetation boxes containing calcareous soils with white, blue, and yellow lupines, peas, vetches, and mustard. Of the first three the white lupine alone survived. Vetches gave by far the most satisfactory results as regards total yield and proportion of nitrogen. During the experiments with catch crops (October and the early part of November) the bare soil lost 28 kg. of nitric nitrogen per hectare and the soil covered with vetches 7 kg. The difference (21 kg.) added to the amount of nitrogen furnished to the soil by the crop of vetches (82 kg.) supplied the covered soil with an excess of nitrogen over the bare soil of 103 kg., or an amount furnished by 40 tons of barnyard manure, or 730 kg. of nitrate of soda.

The influence of the rolling of crops upon their productiveness, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 3, pp. 231–253*).—The author states that the operation of rolling young crops is applied for 3 purposes, (1) to check luxuriance of growth which causes lodging, (2) to induce tillering and consequent improvement of the stand of the crop, and (3) to promote formation of new roots by plants which have been upheaved by freezing and thawing of the soil. He discusses the physiological principles upon which these effects are supposed to be based, reviews at some length the experiments of W. Schumacher[1] and C. Kraus,[2] and notes the work and conclusions of other writers upon this subject.

It has been assumed that the bending down or crushing of the stems produced an advantageous effect by causing a thickening of walls of the uninjured cells, thus making more stocky plants, and by inducing development of side shoots. The checking of the luxuriance of growth also admits more light and air to the remaining uninjured shoots, and by thus stimulating assimilation it is thought exerts a favorable influence upon the crop. Frequently new roots form at the nodes of

[1] Korn und Peters, Landw. Jahrb., 3 (1872), p. 183.

[2] Forsch. Geb. agr. Phys., 13 (1890), pp. 252–293; 14 (1891), pp. 77–96.

the crushed stems and this change in plant circulation has been regarded as a factor in influencing productiveness. According to Schumacher, rolling also exerts an advantageous influence, especially in the case of potato plants, in so far as the tension of the tissues is increased by injury of the stems and assimilation in the uninjured portions is increased in the same degree.

How far these assumptions correspond with actual conditions the author was unable to determine from previously reported work, as the experiments had not been made with sufficient regard to the requirements, and contradictory results had been obtained.

To establish a satisfactory basis for the study of these points a series of vegetation experiments was carried out by the author in which plants grown under similar conditions on like plats remained undisturbed or were rolled down at different stages of development.

The tests were made with cereals, legumes, rape, and *Camelina sativa* for 2 years, and with potatoes for 4 years. Tables are given showing detailed data for each crop, and the conditions and conclusions are fully discussed, the work upon potatoes being considered separately.

The tables show, according to the author, that with few exceptions rolling the grain crops resulted in a decreased yield; that the injurious effect was more marked the later the rolling was done, and that under favorable vegetative conditions the injury was slight or there was even a gain.

With potatoes the results were more favorable, as the yield was increased when the plants were rolled in their early stages of development (June 11 to 26), and was sometimes increased and sometimes diminished when the fully formed vines were rolled (July 16 to 26). The influence of the weather was as marked upon the potatoes as upon the grains, the favorable effect of the rolling being increased and its injurious effect lessened when warm, moist weather followed the operation.

The author believes rolling useful for breaking the crust which may form over the seed upon some soils, for reëstablishing plants upheaved during the winter, and for compacting soils in regions exposed to hot, drying winds; but the experiments afforded no test upon these points.

The nitrogen requirement of barley, H. HELLRIEGEL ET AL. (*Ztschr. Ver. Rübenz. Ind., 1897, Feb., pp. 141–217*).

Chicory culture in Nebraska (*Amer. Agr. (middle ed.), 59 (1897), No. 12, p. 353, fig. 1*).

Important facts about corn, W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 127–130*).—A reprint of Bulletin 17 of the station (E. S. R., 7, p. 121).

Forage conditions of the prairie region, J. G. SMITH (*U. S. Dept. Agr. Yearbook 1895, pp. 309–324, figs. 5*).—A popular article on the wild forage plants of the prairie regions. Notes are given on the blue stems (*Andropogon furcatus, A. nutans*, and *A. scoparius*), switch grass (*Panicum virgatum*), the wheat grasses (*Agropyrum spicatum, A. caninum, A. richardsoni, A. tenerum*, and *A. repens*), the gramas or mesquite grasses (*Bouteloua curtipendula, B. oligostachya*, and *B. hirsuta*), buffalo grass (*Buchloe dactyloides*), prairie June grass, (*Eatonia obtusata* and *Kœleria cristata*), fresh-water cord grass (*Spartina cynosuroides*), wild-rye grass (*Elymus* sp.), blue stems (*Calamagrostis*

canadensis, *C. confinis*, and *Calamovilfa longifolia*), turkey foot (*Andropogon hallii*), the needle grasses (Aristida and Stipa), the false redtops (*Eragrostis pectinacea* and *Triodia purpurea*), native clovers (Petalostemon), vetches (Vicia and Lathyrus), shoe-strings (Psoralea, Dalea, and Amorpha), rattle pods (Astragalus), and beggar weeds (Desmodium).

A report on the grasses and forage plants of the Rocky Mountain region, P. A. RYDBERG and C. L. SHEAR (*U. S. Dept. Agr., Division of Agrostology Bul. 5, pp. 48, figs. 29*).—Descriptive, illustrated, and economic notes are given on collections of grasses and other forage plants made in Montana, Idaho, Utah, Colorado, and Nebraska. The authors call attention to certain grasses deserving particular mention and give miscellaneous notes on grasses adapted for hay and pasture as well as forage plants other than grasses. A list of characteristic species adapted for particular soils and stations is given.

Grass gardens, F. LAMSON-SCRIBNER (*U. S. Dept. Agr. Yearbook 1895, pp. 301–308, figs. 2*).—The author discusses the value of grass gardens in the recognition and comparison of species, and mentions the advantages of such gardens and their value in the selection of grasses for particular latitudes. Brief directions are given for laying out and stocking grass gardens, together with suggestions for different kinds of grass and forage plants to be grown, as well as the importance of introducing new grasses.

Comparative variety tests of summer grains, TANCRÉ (*Landw. Wochenbl. Schles. Holst., 47 (1897), No. 9, pp. 152, 153*).

Grasses of salt marshes, F. LAMSON-SCRIBNER (*U. S. Dept. Agr. Yearbook 1895, pp. 325–332, figs. 5*).—This is a popular article on the grasses of the salt and tide-water marshes. On the sands are found beach or marram grass and a few others valuable for holding drifting sands. On the marshes proper grow sedge or thatch (*Spartina stricta glabra*), red salt grass (*S. juncea*), which is one of the most valuable of the spartinas for hay, *S. junciformis*, fresh-water cord grass (*S. cynosuroides*), *S. polystachya*, large reed (*Phragmites communis*), Indian rice (*Zizania aquatica*), and spike grass (*Distichlis spicata*). Upon the higher portions of the marsh, above the ordinary tides, are found creeping bent or browntop, switch grass (*Panicum virgatum*), slender broom sedge (*Andropogon scoparius*), and a rush, called black grass (*Juncus gerardi*).

Hemp culture, C. R. DODGE (*U. S. Dept. Agr. Yearbook 1895, pp. 215–222*).—This is a popular article giving general considerations on the hemp crop in the United States, with directions for culture. A great desideratum in hemp production is a satisfactory breaking machine, which so far has not been placed on the market.

Results of experiments with commercial fertilizers on hops, F. L. SCHNEIDER (*Časopis pro průmyls chemicky, 6 (1896), p. 251; abs. in Chem. Ztg., 21 (1897), No. 3, Repert., p 2*).

Canadian field peas, T. SHAW (*U. S. Dept. Agr. Yearbook 1895, pp. 223–232, figs. 3*).—This is a popular article containing some general remarks on the value of the pea crop, with directions for culture. The varieties recommended are Prussian Blue, Canadian Beauty, and Tall White Marrowfat.

Potatoes at the Chapelle experiment station, F. DESPREZ (*Jour. Agr. Prat., 61 (1897), I, Nos. 9, pp. 313–320; 10, pp. 364–367*).

Wheat, thick and thin seeding, R. H. MCDOWELL (*Nevada Sta. Rpt. 1895, pp. 9–11*).—Tabulated data are given for tests carried on for 5 years in sowing different amounts per acre of seed wheat.

The principal varieties of wheat consumed in France, BALLAND (*Compt. Rend., 124 (1897,) No. 1, pp. 40–42*).—Analyses of wheat from various sources, including the United States.

Comparative test of Sorghum vulgare and horse tooth corn, OTTO (*Deut. landw. Presse, 24 (1897), No. 19, p. 165*).—Tables are given showing comparative yield and composition of these crops.

The influence of the nitrogen content of the soil upon the ratio between grain and straw (*Deut. landw. Presse, 24 (1897), No. 17, p. 145*).—Review of work of Fleischer,

showing an almost uniform widening of the ratio between grain and straw with increased nitrogen content of soil.

Distribution of seeds and plants, E. J. WICKSON (*California Sta. Bul. 112, pp. 8*) — A descriptive list is given of selected resistant grapes, table grapes from Persia, desirable eucalypts, silk cotton tree (*Eriodendron anfructuosum*), carob (*Ceratonia siliqua*), dry land grasses, plants for green manuring, forage plants for alkali soils, cañaigre, kale, Jerusalem artichokes, Algerian wheats, vegetables, and tobacco, which are offered by the station for distribution to citizens of the State.

HORTICULTURE.

Notes on cabbages, H. P. GOULD (*Maine Sta. Rpt. 1895, pp. 82–88*).—The author reports on the influence of size of seed, results of tying up the outer leaves to hasten maturity, effect of mulching, and shallow *vs.* deep cultivation.

In testing the influence of the size of seed, plants from large and small seed from 3 varieties were grown, and the results are tabulated. The weight of the heaviest and lightest heads, the average weight, and the percentage of cracked heads, immature heads, and plants not forming heads are given, together with the ratio of the average weights of heads from large and small seed. For one variety the small seed produced heavier heads than the large, but with the other two the ratio was reversed, from which it seems probable that the size of the seed has some influence upon the size of the head, the larger seed as a rule producing larger heads.

The effect of tying up the outer leaves upon the maturity of the plant was investigated and the results tabulated, in which it was shown that tying up the outer leaves of the cabbage appeared to have no effect upon the maturity of the heads, but resulted in a marked decrease in their size and in increased liability to decay.

The effect of mulching with straw was tested and the results tabulated. It is shown that the use of a mulch in growing cabbages, especially in a dry season, is advantageous.

Shallow and deep cultivation were tried with 4 varieties of cabbage, and it appears from the tabulated data that the different methods of culture did not affect all varieties in the same way. In general, deep cultivation appears to hasten maturity of plants, as is shown by the greater percentage of cracked heads from the deeply cultivated plants and by the greater percentage of immature plants from those given shallow cultivation. The size of the head did not seem to be influenced by the different methods of culture.

Onions, L. C. CORBETT (*South Dakota Sta. Bul. 47, pp. 33–39, 46*).—Plantings were made February 27 and March 18 of each of 7 varieties of onions. For 1 variety the yields were alike for both plantings, but for the other 6 varieties there was a marked difference in favor of the earlier date, as great in one case as 115 bu. per acre. The data are tabulated.

Comparisons were made on 7 varieties of plants raised in hotbeds and transplanted, and plants from seed sown in the open field, the dates of sowing being the same. The field-sown seed gave the largest product with 5 varieties, the same amount of merchantable onions, but smaller amount of scullions with 1 variety, and a decidedly inferior yield with 1 variety. The bulbs produced by the transplanted plants were larger than those grown in the field, due, perhaps, to insufficient care in thinning the field-sown plants.

One-half of a large plat of ground was plowed and prepared in the fall and the other half in the spring a few days prior to sowing the seed. It was found that the seed on the fall-plowed section germinated 2 days earlier than that on the spring-plowed section, and that the work of weeding was considerably less on the fall-plowed land. At harvest the yields were: For fall-plowed section, 369.59 bu. merchantable onions and 8.56 bu. of scullions; for spring-plowed section, 303.61 bu. merchantable and 16.24 bu. scullions.

Spinach, L. F. KINNEY (*Rhode Island Sta. Bul. 41, pp. 99–131, figs. 14*).—Notes are given on spinach culture in Rhode Island, with a classification of the various varieties, dividing them into 6 groups, as follows: Norfolk or Bloomsdale spinach, round-leaved spinach, thick-leaved spinach, prickly-seeded spinach, New Zealand spinach, and mountain spinach or garden orache. The different varieties of each are described.

The author investigated the use of water in connection with the cultivation of spinach by subirrigation and surface irrigation. In the case of the subirrigation but little, if any, benefit was observed, while the use of water on the surface conspicuously hindered the growth of the plants during the few days that followed the application.

Brief notes are given on the leaf miner and mildew of spinach, and the author thinks there are indications that the germs of the mildew are carried to the field upon the seed when sown.

A historical sketch of the cultivation and use of spinach is given, with directions for proper cooking.

Notes on sweet corn, H. P. GOULD (*Maine Sta. Rpt. 1895, pp. 79–81*).—Tests of 25 varieties of corn are reported, and attention is called to the fact that the Cory variety for several years has excelled in earliness, but its quality is far from perfection. In the tests here reported several varieties are shown to have the same growing season as reported for the Cory, namely, 79 days from the date of planting. Early Sunrise, the most prolific and one of the earliest varieties grown, compared favorably in quality with the later varieties.

Tomatoes, L. C. CORBETT (*South Dakota Sta. Bul. 47, pp. 4–32, 45, 46*).—A table is given showing dates of first bloom and first ripe fruit, average numbers of fruits per plant, average weight of fruits, and average yield per acre of 102 varieties of tomatoes grown at the station under similar conditions. Of the varieties tested 19 produced at the

rate of over 300 bu. per acre, 3 over 400 bu., and 1 over 500 bu., the best producers being Hubbard Early, Salzer Giant Tree, Salzer First Prize, Bond Early Minnesota, and Early Ruby.

A fertilizer test was made with nitrate of soda, potash salts, superphosphate, land plaster, and salt, singly in varying amounts and variously combined. The data are tabulated and indicate beneficial results from the use of small quantities of phosphoric acid.

A plat of 40 plants tilled with rake and hoe gave earlier fruits than one cultivated 3 in. deep, but the fruits were less in number and of smaller size, the calculated yields per acre being 332.53 bu. for the raked plat and 446.13 bu. for the cultivated plat. Mulching retarded the maturity of the fruit.

In a comparison of different systems of training, a perpendicular 3-wire trellis gave best results, but the author concludes that "in general it does not pay to train tomatoes."

Plants grown from cuttings carried through the winter were compared with plants from seed of the same variety. The results both in general yield and in work involved were in favor of the seedling plants.

Seed was sown at different dates between January 16 and April 16, the largest crops being produced by the plantings nearest March 15.

To test the theory that removing the new growth and blossoms after the plants have set the desired number of fruits will hasten the maturity, one lot of plants was pruned August 3 and a similar lot allowed to grow naturally. The pruned plants were checked rather than hastened in maturity, as only 1.5 fruits per plant ripened by August 31, at which time 4.4 fruits per plant had ripened on the unpruned lot. The yield for the entire season, however, favored the pruned plants, the yields being at the rate of 460 bu. per acre pruned, and 293.5 bu. normal.

Trials were also made to test the influence of soaking seed in water as in the cleaning process, and to compare normal, sun-ripened, and green seed, and home-grown and foreign seed. The conclusions are that "the washing of seeds from the pulp can in no wise injure them for seed. . . . Seeds from green fruits give a lower percentage of germination, but the resulting plants give an increased crop for the season. . . . While the home-grown seeds do not give earlier fruits, they give a larger yield."

The peach, R. H. PRICE (*Texas Sta. Bul. 39, pp. 801–848, figs. 21*).—This comprehensive bulletin on the peach treats of varieties, with a classification of those adapted to different climates, rules of nomenclature, and peaches recommended by different Texas horticulturists, with directions on orchard setting and budding.

The author classifies the various varieties according to the 5 following races: Peen-To, South China, Spanish, North China, and Persian, the different varieties under each being described, and notes given on

their value for home and market use. The characteristics of the different races are described, and illustrations are given of the characteristic stones and the 1 and 2 year-old wood of each race.

Directions are given for orchard setting and management, in which the preparation of the soil, selection and planting of trees, methods of pruning, and cultivation are treated at considerable length. A method of budding, which can be done when the bark does not slip and the sap is almost dormant, is described and figured. This method, which has been claimed as new, is found to be a modification of a method which has been used for a considerable time in parts of Germany.

Strawberries, H. N. STARNES (*Georgia Sta. Bul. 32, pp. 433–489, pls. 4, figs. 24*).—The author gives directions for the general culture of strawberries, and also the local methods followed in various parts of Georgia and neighboring States. A report is given of variety tests and a description of the varieties.

Summarizing the results of investigations, the author states that any soil or location adapted to trucking purposes is suitable for growing strawberries. The preparation should be deep and thorough. It is recommended that cowpeas be grown as a preparatory crop, and that a very liberal application of barnyard manure be given. A supplementary commercial fertilizer, consisting of 1,140 lbs. of superphosphate, 540 lbs. of nitrate of soda, and 320 lbs. of muriate of potash, applied at the rate of from 800 to 1,600 lbs. per acre, is recommended. Top-dressing in the spring with 150 lbs. of nitrate of soda in 3 applications is advised. The biennial system of rotation is recommended for the interior of the State, but for the coast region the annual system is found best.

Pistillate plants are found as a rule to be more resistant to late frost than staminate ones, and experiments seem to indicate that as a class they are somewhat more productive also. If pistillate varieties are chosen, every third row should be planted with staminate varieties to secure perfect fertilization. Care must necessarily be taken to select pistillate and staminate varieties that will bloom at the same time, in order to secure the best results.

Transplanting should be done in late summer or early fall on the coast and in early November in the interior of the State, followed by resetting in February or March when necessary. The best distances for hill culture are variable, from 36 by 18 to 36 by 24 in. being recommended. In matted rows, 48 by 18 in., the runners being allowed to make a row about 18 in. wide, leaving 30 in. for cultivation, is considered the best distance. In the annual rotation no cultivation after fruiting, except the eradication of the larger weeds, is necessary. In the biennial rotation continuous cultivation throughout the first season must be followed. Mulching previous to fruiting is recommended, the most economical material being pine straw. The mulch should never be burned off, but turned under with the plants when the plat is destroyed.

Irrigation experiments have proved unsatisfactory, and should not be undertaken except in an experimental way.

The principal insect enemies of the strawberry are the white grub and the crown borer, and the most effective means for prevention is rotation, at least 3 years, and 5 years if possible, intervening between crops. The strawberry leaf blight (*Sphærella fragariæ*) is the most serious fungus pest, and rotation and spraying with Bordeaux mixture are recommended.

The best succession of varieties for home use or local market is stated to be Hoffman, Lady Thompson, Sharpless, Beder Wood, Gandy Belle, Greenville, Brandywine, Marshall, Haverland, Princess, Parker Earle, and Bubach No. 5. The best succession for shipping is Hoffman, Lady Thompson, Beder Wood, Haverland, Parker Earle, and Bubach No. 5.

Strawberries, W. PADDOCK (*New York State Sta. Bul. 109, n. ser., pp. 231–250, pl. 1*).—Descriptive notes and summary of variety tests are given. Strawberries were fruited in 1 and 2 year-old beds and, "contrary to the usual experience," some of the largest yields were obtained from beds that bore their second crop of fruit this season. Of the varieties fruited for the first time this season the author considers Bissel, Earliest, Enormous, Maple Bank, Omega, Robinson, See No. 3, No. 4, and No. 5, Staples, Thompson No. 101, Tubbs, and William Belt worthy of further testing. Among the varieties fruited in the 2 year-old beds for the second time only, the following are considered worthy of testing: Bostonian, Marshall, Marston, and Tennessee. Among the most promising early berries may be mentioned Earliest, Michel, Staples, Tubbs, Beder Wood, and Marston; and of the very late varieties, Hunn, Equinox, Wilder No. 7, Feicht No. 3, Princeton, Chief, and Gandy.

Varieties of grapes, R. L. WATTS (*Tennessee Sta. Bul., Vol. IX, No. 4, pp. 167–195, figs. 10*).—A report is given of varieties of grapes tested during 1896. There were 63 varieties tested at the station and 7 additional ones are reported from Tennessee growers, but which have not been tested at the station. Two new varieties, Campbell Early and Early Ohio, both of which promise to be valuable additions, are reported upon at some length. For home consumption the following varieties will furnish a succession of fruit in the latitude of the station from the middle of July until after frost: Early Ohio, Moore Early, Delaware, Worden, Winchell, Brighton, Brilliant, Catawba, Duchess, Herbemont, Clinton, and Norton Virginia. The most profitable market varieties are Moore Early, Niagara, Concord, Delaware, Diamond, Catawba, Woodruff, and Carman.

California walnuts, almonds, and chestnuts, G. E. COLBY (*California Sta. Bul. 113, pp. 13*).—Studies have been made relative to the composition of numerous varieties of walnuts, almonds, and chestnuts, and the fertilizers required to replace the draft upon the soil. Five samples of walnuts, 10 of almonds, and 2 of chestnuts were examined,

the results being tabulated. The physical analyses and ash and nitrogen content of the different parts of the fresh nuts were as follows:

Analyses of California nuts.

	Physical analysis.			Ash and nitrogen content.							
	Total weight.	Average weight of nuts.	Average weight of kernels.	Hulled nuts.		Kernels.		Shells.		Hulls.	
				Ash.	Nitrogen.	Ash.	Nitrogen.	Ash.	Nitrogen.	Ash.	Nitrogen.
Walnuts:											
California Softshell	*Gms.* 33.30	*Gms.* 13.30	*Gms.* 6.00	*Pr. ct.* 0.78	*Per ct.* 1.00	*Pr. ct.* 1.16	*Per ct.* 1.82	*Pr. ct.* 0.61	*Per ct.* 0.32	*Pr. ct.* 1.15	*Per ct.* 0.11
Do	33.30	15.80	6.65	.64	1.00	1.05	2.09	.35	.21	1.83	.28
Do	25.00	13.30	5.10	.83	1.08	1.18	2.45	.62	.23	2.21	.17
Bijou	80.00	31.00	8.34	.68	.84	1.36	2.40	.41	.20	1.06	.15
California Native Black	50.00	14.10	3.75	.57	.98	1.36	3.16	.30	.20	.51	.12
Almonds:											
I X L	5.20	2.60	1.30	2.08	1.70	2.00	3.05	2.24	.37	3.72	.55
King Softshell	9.10	2.30	1.36	1.15	1.49	1.48	2.28	.73	.31	1.11	.11
Nonpareil	9.10	2.70	1.46	1.55	2.13	1.55	2.98	1.83	.37	2.06	.31
Ne Plus Ultra	10.00	3.00	1.88	2.21	2.34	2.16	3.42	2.30	.51	2.66	.64
Marie Dupreys	11.10	5.00	2.22	1.05	1.11	1.27	2.13	.85	.30	1.39	.25
I X L	12.50	3.70	2.09	2.13	2.27	2.07	3.62	2.21	.52	2.41	.38
Drake Seedling	16.60	5.00	1.65	1.02	.96	1.49	2.41	.80	.23	1.32	.12
I X L	20.00	7.00	2.60	1.27	.78	1.20	1.87	1.31	.16	1.06	.13
Papershell	20.00	3.00	2.10	1.26	1.72	1.62	2.42	.44	.10	1.17	.16
Languedoc	25.00	4.50	2.49	1.27	1.41	1.45	2.43	1.30	.14	1.17	.20
Chestnuts:											
Italian	50.00	28.50	24.08	.83	1.02	.75	1.06	.99	.76	1.22	.50
Do	33.33	21.67	18.34	.80	.59	.83	.65	.63	.26	1.09	.22

Ash analyses are given for the various parts of the fruit of California-grown walnuts, almonds, and chestnuts, and for comparison European ash analyses are included.

Amount and composition of the ash of California walnuts, almonds, and chestnuts.

Nut (hulled) and parts of entire fruit.	Pure ash in fresh substance.	Composition of the pure ash.									
		Potassium oxid.	Sodium oxid.	Calcium oxid.	Magnesium oxid.	Peroxid of iron and alumina.	Manganic oxid.	Phosphoric acid.	Sulphuric acid.	Silica.	Chlorin.
Walnut:											
Nut (hulled)	*Per ct.* 0.750	*Per ct.* 19.96	*Per ct.* 0.83	*Per ct.* 23.83	*Per ct.* 11.40	*Per ct.* 2.49	*Per ct.* 0.64	*Per ct.* 37.17	*Per ct.* 2.17	*Per ct.* 0.94	*Per ct.* 0.57
Kernel	1.130	12.69	.96	5.57	16.60	3.23	.35	57.83	1.31	.75	.70
Shell	.520	28.28	.82	44.88	5.29	1.78	.96	13.14	3.23	1.17	.41
Hull	1.730	77.80	.27	7.79	1.80	.62	.12	2.46	2.66	1.28	6.57
European walnut (meal)	5.350	33.08	......	6.76	12.15	.30	......	43.74	1.23	1.61	.22
Almond:											
Nut (hulled)	1.500	36.63	2.29	11.49	12.23	1.99	.35	28.90	4.12	1.32	.21
Kernel	1.620	10.96	1.85	14.53	18.31	.78	.28	48.13	4.64	.24	.27
Shell	1.440	64.76	2.81	9.12	5.54	3.40	.42	7.76	3.55	2.48	.14
Hull	1.830	64.86	.74	4.10	5.28	4.26	.59	5.62	1.32	12.51	.70
European almond (nut)	4.900	27.95	.23	8.81	17.66	.55	......	43.63	.37	......	......
Chestnut:											
Nut (hulled)	.826	45.07	1.70	8.82	9.24	.43	.18	23.10	10.84	.22	.40
Kernel	.790	48.67	1.20	4.63	8.05	.41	.16	23.55	12.81	.18	.34
Shell	.810	29.02	3.92	27.52	14.51	.47	.24	21.10	2.08	.42	.67
Hull	1.160	32.23	.99	17.83	10.15	3.93	.58	9.61	5.05	18.69	.90
European chestnut—											
Nut	1.980	39.36	21.73	7.84	7.84	1.03	......	8.25	3.88	2.32	2.93
Kernel	2.380	56.69	7.12	3.87	7.47	.14	......	18.12	3.85	1.54	.52
Shell	1.680	2.53	14.21	19.74	24.07	.87	......	9.89	3.39	3.51	4.54

The total quantity of mineral matter withdrawn, as shown by the ash, is considerably greater for all the nuts than for the stone fruits, with the exception of the olive. In the case of the olive the excess consists mostly of silica, the ash containing 88 per cent of that substance.

Investigations have been made on the food value of nuts, and a summarized table is given of the analyses. In the following table the author's analyses are given and for comparative purposes some European analyses and the analyses of 8 specimens of Pennsylvania-grown chestnuts are included:

Proximate composition of the water-free kernels of nuts.

	Number of analyses.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		Per ct.	*Per cent.*	*Per ct.*	*Per cent.*	*Per ct.*
Walnuts:						
California-grown, California Softshell	4	1.44	16.99	2.62	13.87	65.08
California-grown, Bijou	1	1.71	18.84	1.50	11.88	66.04
European-grown, English walnut[1]		2.13	17.17	6.47	8.28	65.95
California Native Black	1	1.77	25.56	1.90	14.71	56.06
California-grown, American Black	1	2.06	31.06	1.65	5.93	59.30
Almonds:						
California-grown, different varieties	11	2.14	22.02	3.23	14.99	57.62
European-grown, sweet almond[1]	1	3.13	25.56	6.93	7.64	56.74
Chestnuts:						
California-grown, "Italian"	2	1.68	11.55	3.10	78.45	4.22
Pennsylvania-grown, different varieties[2]	8	2.89	10.99	3.13	71.76	11.63
European-grown, average[1]		3.54	11.29	3.32	79.03	2.82

[1] König. [2] Pennsylvania Sta. Bul. 16 (E. S. R., 3, p. 177).

Where other forms of food lack protein or albuminoids and fat, walnuts and almonds are able to supply this deficiency in a concentrated form. The chestnut with its high content of starch, sugar, dextrin, etc., may be used as a substitute for the cereals.

The bleaching of nuts by dipping, E. W. HILGARD (*California Sta. Bul. 113, pp. 14, 15*).—The unsatisfactory results often secured in the usual method of bleaching nuts by the use of sulphur have led to an investigation of this subject with a view to securing some more satisfactory method of treatment. Very good results have been obtained by dipping the nuts in a cane or splint basket for 5 minutes in a solution of 6 lbs. bleaching powder, 12 lbs. sal soda and 50 gal. of water. They are then thoroughly rinsed with a hose, drained, and dipped in a 1 per cent solution of bisulphite of lime until the desired color is secured, after which the nuts are again rinsed and dried. Instead of the last dipping the same results may be obtained by sulphuring the nuts for 10 to 15 minutes. The cost of 50 gal. of the chlorin dip will be about 40 cts., and the same quantity of the bisulphite would probably cost less. The time occupied in handling a lot of nuts will be from 12 to 15 minutes. If practiced upon an extensive scale, some modifications will doubtless be suggested, but the method as a whole is considered far superior to the use of the sulphur box. For English walnuts either of the two bleaching dips may be used alone.

Electro-horticulture, range of incandescent light, F. W. RANE (*Proc. Soc. Promotion Agr. Sci. 1896, pp. 105–108, figs. 3*).—An account is given of an experiment made at the West Virginia Station with a cluster of 8 16-candlepower bulbs. They were placed at the end of a central bench and the light thrown along the bench by a reflector. The plants used in the test were spinach, lettuce, land cress, and cauliflower. The light was kept running from about 5 to 11 p. m. for 6 nights per week, from November 6 to January 11. There seemed to be no effect exerted upon the cress except possibly an earlier germination, but the growth of the other plants was accelerated to the following distances from the light: Cauliflower, 20 feet; Grand Rapids lettuce, 19 feet; Rawson Forcing House lettuce, 6.5 feet, and spinach, 16.75 feet. The cauliflower grew taller near the light, but gave larger heads when farther away. In general, the lettuce gained in height but lost in weight as it approached the light.

The two freezes of 1894 and 1895 in Florida, and what they teach, H. J. WEBBER (*U. S. Dept. Agr. Yearbook 1895, pp. 159–174, pl. 1, figs. 7*).—An account is given of the two freezes and the amount of damage done in Florida in 1894 and 1895. The first freeze, December 27–29, caused a serious loss of oranges and lemons, killed many of the young citrus trees, and seriously injured the old ones. Guavas, pineapples, and many tropical fruit trees were frozen down throughout the northern and central parts of the State.

The second freeze, which culminated on February 8, killed all the varieties of citrus trees throughout the State except in the extreme southern portion and in a few protected localities. Where the trees had been banked with earth before the freeze a portion of the trunk was saved, and this practice is thought desirable in order to protect the point of union in trees budded or grafted near the ground. Citrus trees having a single main trunk were found to endure cold better than those having several trunks. Wind-breaks, forest trees scattered among fruit trees, and fires distributed at intervals proved beneficial. Little difference was noticed in the subsequent growth of frozen trees whether pruned soon after the freeze or left unpruned. No injurious effects were observed from leaving the frozen tops attached, but it is thought in general that early pruning gave rather better results. In restoring orange and lemon groves frozen to the ground, the method of cutting the trees off below the soil and crown grafting has proved much better and quicker than waiting for sprouts to grow from the base and budding them when they have reached sufficient size. What appeared to be the quickest way to build up nursery stock and small trees killed down by the freeze was to immediately cut them an inch or two below the surface of the ground and cleft graft them.

Pineapples were injured as far south as Biscayne Bay when grown in the open. When grown under sheds they were not seriously injured south of the 27th parallel. The strictly tropical fruits were injured

except in the extreme southern part and on the Keys. Large bodies of water afforded protection to citrus trees growing in their vicinity, the tempering influence of the large lakes being perceptible for at least half a mile from the water. On an island in Tampa Bay lemons escaped uninjured, and oranges on the bordering mainland were almost entirely unharmed. The beneficial influence of this large body of water extended for nearly 2 miles. Pineapples, guavas, etc., grown in regions having extensive water protection escaped much of the damage sustained by such fruit when grown in similar latitudes, but away from bodies of water.

Second report upon extension work in horticulture, L. H. BAILEY (*New York Cornell Sta. Bul. 122, pp. 471–504, figs. 14*).—This bulletin gives a report on the progress of the work carried on under the Experiment Station Extension, or Nixon, Bill, and covers the third year's work. The general outline of work, as given in the previous report, has been somewhat modified. The methods of extension which have been tried are (1) the itinerant or local experiment as a means of teaching, (2) the readable expository bulletin, (3) the itinerant horticultural school, (4) elementary instruction in rural schools, and (5) instruction by means of correspondence and reading courses. The author considers that the bulletins have accomplished the greatest good. An outline is given in part of the various courses which have been offered and lines of instruction which have been carried out. Courses of reading are also suggested and lists of publications given which deal more or less directly with the lines of instruction desired. The work as originally contemplated under the law establishing the extension work in horticulture has grown to such proportions that it can be no longer handled by the regular organized staff of the College of Agriculture of Cornell University, and the author offers some suggestions for its future conduct.

Asparagus planting, W. ALLAN (*Garden, 51 (1897), No. 1319, p. 159*).

Beans, L. C. CORBETT (*South Dakota Sta. Bul. 47, pp. 40–42, 46*).—A table is given showing the yield of 20 varieties of string beans grown at the station. Tests of hills *vs.* drills on both small and large scale favored sowing in drills.

Storing of celery, I. L. POWELL (*Amer. Gard., 18 (1897), No. 116, p. 171, fig. 1*).—Directions are given for winter storing of celery which is said to excel in producing a fine, crisp product.

Notes on peas, H. P. GOULD (*Maine Sta. Rpt. 1895, pp. 81, 82*).—Tests are reported of 8 varieties of "wrinkled" peas, in which it is shown that considerable latitude in time is required by different varieties to reach edible maturity.

Salad plants and plant salads, F. A. WAUGH (*Vermont Sta. Bul. 54, pp. 67–79, figs. 8*).—The author distinguishes between salad plants proper and those suitable for pot herbs or greens. Among the salad plants proper he describes cresses, white mustard, and corn salad, and among those suitable for pot herbs, Swiss chard, spinach, endive, and kale. In addition to those described a list of about 30 other salad plants is given. Brief notes are given on the preparation of salads and salad dressings.

Vegetables in 1894, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1895, pp. 113–120*).—Lists are given of the varieties of bush Lima beans, pole beans, beets, lettuce, and cauliflower grown at the station, and tabulated data and notes upon 10 varieties of bush beans, 12 of cabbage, 13 of sweet corn, 24 of peas, and 19 of tomatoes.

Experiments with vegetables and fruits, E. S. RICHMAN (*Utah Sta. Bul. 45, pp. 19*).—These consist principally of variety tests, tabulated data being given for 24 varieties of potatoes with descriptions of 8 varieties, and notes upon 19 varieties of onions, 2 of field beans, 7 of Lima beans, 5 of string beans, 12 of sweet corn, 6 of muskmelons, 4 of watermelons, 6 of cherries, 7 of plums, 21 of apples, 3 of pears, and Spanish peanuts.

A trial of transplanted and field-sown onions resulted decidedly in favor of transplanting. The yield of potatoes from small potatoes and from equal-sized pieces of large potatoes favored the small potatoes.

A cheap and efficient greenhouse for the Northwest, L. C. CORBETT (*South Dakota Sta. Bul. 47, pp. 43–45*).—Reprint of an article published in *Market Garden, June, 1895*.

The health of plants in greenhouses, B. T. GALLOWAY (*U. S. Dept. Agr. Yearbook 1895, pp. 247–256, figs. 4*).—The author discusses some of the various factors affecting the health of plants in greenhouses and shows in what way the soil, water, heat, and light may affect plants grown in such conditions. Selection as a means of increasing the vigor of plants is discussed and illustrated by figures showing violet cuttings properly and improperly made.

Apple growing in Grand Isle County, F. A. WAUGH (*Vermont Sta. Bul. 55, pp. 83–95, figs. 9*).—An account is given of the apple industry in Grand Isle County in Northwestern Vermont. The county is almost completely surrounded by Lake Champlain and comprises about 50,000 acres. Statistics are given for the crop of 1896 which show that there were at that time 192 growers, whose 34,885 bearing trees produced 40,424 bu. of marketable apples. The methods of cultivation are described in considerable detail. Spraying is followed almost universally, the more successful growers giving usually 4 applications of Bordeaux mixture to trees during the season. With the exception of the first application, which is given before the buds start, Paris green is added to the solution. The more important varieties are listed and directions are given for picking, storing, and marketing the fruit. A tabulated statement is given, showing that one grower with a 20-acre orchard made during the past year a net profit of $34.80 per acre.

Apples in 1895, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1895, pp. 132–135, pls. 2*).—Descriptions with illustrations are given of 6 varieties of apples of recent introduction and 5 Russian apples.

Cordon pear trees, F. BOULON (*Amer. Gard., 18 (1897), No. 116, p. 169, fig. 1*).—Directions are given for planting and training. Dwarf stock is preferred, and early bearing varieties are considered best.

Pear budding, C. GROSDEMANGE (*Rev. Hort., 69 (1897), No. 3, pp. 61, 62, fig. 1*).

The pineapple industry in the United States, H. J. WEBBER (*U. S. Dept. Agr. Yearbook 1895, pp. 269–282, pl. 1, figs. 6*).—Notes are given on the extent of the pineapple industry in Florida and the conditions affecting growth, such as heat, soil, moisture, etc. The methods of culture are described and the varieties principally grown are mentioned. The methods of propagation of plants, planting, cultivation, gathering, and packing the fruit are given, together with brief notes on diseases of the pineapple. The principal diseases are "sanding," long leaf or spike, blight, and those caused by pineapple mite or red spider, and the mealy bug. Suggestions are given for their prevention.

Blackberries and how to grow them, R. M. KELLOGG (*Amer. Gard., 18 (1897), No. 116, pp. 170, 171*).

The gooseberry, W. M. MUNSON (*Amer. Gard., 18 (1897), No. 116, p. 171*).—Extracts are given of a paper read by the author before the Maine Pomological Society on pruning, propagation, varieties, etc., of gooseberries.

Small fruits in 1894, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1895, pp. 121–131*).—Notes are given upon 33 varieties of strawberries, 22 varieties of raspberries, and 5 varieties of blackberries. Tables are given showing the weight and size of

berries, length of season, and yield of strawberries, and length of season and yield of raspberries.

Of 14 varieties of strawberries planted in 1891, 8 yielded more liberally in the third than in the second year.

Notes on small fruits, W. M. MUNSON (*Maine Sta. Rpt. 1895, pp. 138–141*).—A reprint of Bulletin 21 of the station (E. S. R., 7, p. 866).

Small fruit culture for market, W. A. TAYLOR (*U. S. Dept. Agr. Yearbook 1895, pp. 283–294, pl. 1*).—The author discusses the choice of location, preparation of soil, manuring, planting and cultivation, pruning, winter treatment, varieties for market, selection of plants, harvesting, and marketing for strawberries, blackberries, raspberries, currants, and gooseberries.

French vines resistant to black rot, E. RISON (*Prog. Agr. et Vit., 26 (1896), No. 10, pp. 271, 272*).—The variety Becut is said to be resistant, but the editor raises the question as to the identity of such a variety.

Training grapes on wires, A. CARRÉ (*Prog. Agr. et Vit., 27 (1897), No. 5, pp. 119–121*).

Grape culture in the greenhouse, R. CAMERON (*Canadian Hort., 20 (1897), No. 3, pp. 105, 106*).

Contribution to the physiology of the graft. Influence of the stock on the scion, G. RIVIÈRE and G. BAILHACHE (*Compt. Rend., 124 (1897), No. 9, pp. 477–480*).

Principles of pruning and care of wounds in woody plants, A. F. WOODS (*U. S. Dept. Agr. Yearbook 1895, pp. 257–268, figs. 5*).—The general structure of woody plants is given and the nature and effect of root and top pruning are discussed. Directions are given for pruning fruit trees to produce vegetative growth and also for greater bearing capacity. The method of healing wounds on stems and branches is mentioned and receipts given for grafting wax, grafting clay, coal tar, and shellac varnish.

Irrigation for the garden and greenhouse, L. R. TAFT (*U. S. Dept. Agr. Yearbook 1895, pp. 233–246, figs. 4*).—A popular discussion of this subject under the following heads: The water supply, power and machinery, distribution, reservoirs and tanks, applying the water, irrigation for the garden, irrigation for orchards, cost of irrigating, profits from irrigating, and irrigation for the greenhouse.

Frosts and freezes as affecting cultivated plants, B. T. GALLOWAY (*U. S. Dept. Agr. Yearbook 1895, pp. 143–158, figs. 8*).—This is a general discussion of the different kinds of frosts and freezes and their effects upon plants. The use of the daily weather map and of the psychrometer in foretelling frosts is explained and directions are given for the protection of plants by covering with straw, soil, etc., by means of screens and wind-breaks, by smoke and fire, and by flooding, irrigating, and spraying.

Orchards and vineyards in the United States, F. SAHUT (*Prog. Agr. et Vit., 27, (1897), No. 10, pp. 284–288*).

Horticulture in colleges, W. E. BRITTON (*Garden and Forest, 10 (1897), No. 473, pp. 107, 108*).

The forcing-book, L. H. BAILEY (*The Macmillan Co., New York, 1897, pp. VII, 266, figs. 88*).—The extent to which the cultivation of vegetables under glass has developed within comparatively few years has caused a demand for some authoritative work giving the latest and best information on the subject. In this work, although the author disclaims being an authority, hints and directions are given which will be found valuable to the amateur grower who seeks a few vegetables for his table as well as for the one who grows for market purposes. Necessarily the construction of greenhouses and their management must be considered and the discussion of the various forms of houses and their details will be found very complete. Soils, fertilizers, irrigation, shading, pollination, etc., have received careful study, and the suggestions offered relative to them will be found the best, so far as the present state of our knowledge goes.

The forcing of lettuce, cauliflower, radish, asparagus, tomatoes, cucumbers, and

muskmelons are discussed in considerable detail, and numerous miscellaneous vegetables capable of forcing are more or less briefly described.

While this manual discusses only the forcing of kitchen garden vegetables, the principles set forth will apply with almost equal weight for producing blooming plants. The questions of starting plants for outdoor planting, hotbeds, and cold frames are intentionally omitted, it being intended that only those plants which are grown to maturity in glass houses should be considered.

The book is based very largely upon work done at the Cornell Experiment Station, but the results of various American workers have been extensively drawn upon, and it presents in convenient form the best practices to be followed.

This valuable work is one of the Garden Craft series, by means of which the publishers are doing so much to spread exact information relative to the plants of our gardens.

Principles of plant culture, E. S. GOFF (*Madison, Wisconsin: Published by the author, 1897, pp. 276, figs. 173*).—This work is an elementary treatise designed as a text-book for beginners in agriculture and horticulture, and is the outgrowth of the author's experience in the lecture room and laboratory while giving instruction in the short course of agriculture at the University of Wisconsin. Primarily intended for students who have had little or no previous instruction in botany, the choice of materials and methods of presentation are such that the underlying principles of plant culture are plainly and accurately presented. The various phases in the life cycle are traced from germination to the decline of growth and rest, and the effect of unfavorable environmental conditions upon plant growth are shown. The different manipulations to be followed in plant propagation, transplanting, and pruning are carefully described, and the methods of plant breeding are briefly given. Simple experiments are suggested and a syllabus of laboratory work added as an appendix. In the hands of competent instructors this book can not fail to be valuable, and the general reader will find it a convenient means for informing himself on the principles underlying plant growth.

Vegetable gardening, S. B. GREEN (*Webb Pub. Co., St. Paul, 1896, pp. 224, figs. 118*).—This book is designed as a manual on the growing of vegetables for home and market use. It was prepared especially for the use of classes in the School of Agriculture of the University of Minnesota, but it will undoubtedly be found adapted to the requirements of vegetable growers in the northern part of the Mississippi Valley. While much in the book has a local cast, it will prove a valuable work for reference wherever vegetables are systematically grown, the monthly calendar being the principal chapter needing modification to be adapted to wide use.

The subject is considered under the following headings: The vegetable garden, irrigation and rotation, manures, tillage, seed sowing, transplanting, the farmer's kitchen garden, seed and seed growing, glass structures, injurious insects, and detailed descriptions of the various vegetables. A monthly calendar for garden work and various tables complete the work.

FORESTRY.

Tree planting in the western plains, C. A. KEFFER (*U. S. Dept. Agr. Yearbook 1895, pp. 341–360*).—The author discusses the general characteristics of the western plains and the object of tree planting and mentions the species valuable for planting in that region. Different methods of planting are mentioned and the objections to the use of a single species are pointed out. Rules are given for mixed planting, and the relative shade endurance and the rate of the development of various species are shown. The author recommends close planting on the western plains and suggests mixtures for adoption.

Notes are given on conifers for western planting and on forest planting in the sand-hills region. General cultural notes are given which are applicable to the cultivation of forest trees throughout the plains region, with the exception of the sand hills. These notes consist of directions for the preparation of the soil, planting, prevention of root exposure, cultivation, pruning and thinning.

The influence of gases and smoke on the growth of conifers, R. HARTIG (*Forstl. naturw. Ztschr., 6 (1897), No. 2, pp. 50–60, figs. 2*).

Variation in maple trees, F. VON SCHIVERIN (*Gartenflora, 46 (1897), No. 3, pp. 59, 60*).

Second growth of white pine in Pennsylvania, C. A. KEFFER (*Garden and Forest, 10 (1897), No. 472, pp. 92, 93*).

Concerning the value of the Weymouth pine (Pinus strobus), L. MAPPES (*Allg. Forst. und Jagd. Ztg., 73 (1897), pp. 51–55*).

Pinus palustris in France, M. L. DE VILMORIN (*Garden and Forest, 10 (1897), No. 474, pp. 112, 113, fig. 1*).—Notes are given on some long-leaf pines planted in France 65 years ago. Two trees were 18 and 16 meters high and 1.7 and 1.5 in circumference. The area adapted to this tree is said to be rather restricted. Loblolly pines planted at the same time are nearly twice as great in bulk as the long-leaf pines.

Conifers at the Kansas Agricultural College, F. C. SEARS (*Garden and Forest, 10 (1897), No. 473, p. 103*).—Notes are given of the spruces.

The Servian spruce (*Gard. Chron., ser. 3, 21 (1897), No. 532, p. 153, fig. 1*).—Illustrated notes are given of *Picea omorica*.

The rotation of species of trees under forest conditions, L. C. CORBETT (*Garden and Forest, 10 (1897), No. 474, p. 118*).

On the relation between floods and forests in Prussia, C. VON FISCHBACH (*Forstw. Centbl., 19 (1897), No. 1, pp. 1–10*).

Methods of exploitation and their influence on forests, K. GAYER (*Allg. Forst. und Jagd. Ztg., 73 (1897), pp. 37–43*).

Tables of forest production, A. SCHIFFEL (*Centbl. ges. Forstw., 23 (1897), No. 1, pp. 6–28, figs. 3*).

Handbook of forestry, I. M. LIZIUS (*Handbuch der forstlichen Baukunde. Berlin: Paul Parey, 1896, pp. XI, 250, figs. 274*).

The relation of forests to farms, B. E. FERNOW (*U. S. Dept. Agr. Yearbook 1895, pp. 333–340, figs. 3*).—The author illustrates the erosive action of water and the methods by which the farmer may reclaim the lost ground, and discusses the relation of forests to the farm in preserving the precipitation, in making the temperature more equable, in protection from extremes of precipitation and drought, and in supplying the farm with useful materials.

SEEDS—WEEDS.

The worst weeds of Wyoming, A. NELSON (*Wyoming Sta. Bul. 31, pp. 265–320, figs. 15*).—Popular notes are given on the nature, evolution, distribution, and classification of weeds, with detailed descriptions and methods for eradication of the following: The Russian thistle (*Salsola kali tragus*), squirrel-tail grass (*Hordeum jubatum*), cockle (*Saponaria vaccaria*), Canada thistle (*Carduus arvensis*), bull thistle (*C. lanceolatus*), prickly lettuce (*Lactuca scariola*), buffalo bur (*Solanum rostratum*), poverty weed (*Iva axillaris*), perennial franseria (*Franseria discolor*), thorny amaranth (*Amarantus spinosus*), common

pigweed (*A. chlorostachys*), rough amaranth (*A. retroflexus*), low amaranth (*A. blitoides*), common tumbleweed (*A. albus*), dandelion (*Taraxacum officinale*).

In addition to the foregoing a list of 50 plants which may be more or less troublesome is given. The necessity for some form of weed legislation is pointed out and suggestions offered for a modification of the law in order to make it more efficient.

Germination of barley as influenced by soaking and drying, A. REICHARD (*Chem. Ztg., 21 (1897), No. 4, pp. 21–23*).

Influence of drying on germination of barley, BEHREND (*Würt. Wochenbl. Landw., 1897, No. 6, pp. 78–80*).

A germinating apparatus (*Gard. Chron., ser. 3, 21 (1897), No. 531, p. 143, fig. 1*).

Investigations of seed-testing methods, HARTLEB and STUTZER (*Jour. Landw., 25 (1897), No. 1, pp. 43–60*).

Seed testing at home, A. J. PIETERS (*U. S. Dept. Agr. Yearbook 1895, pp. 175–184, figs. 3*).—The author in a popular article points out the desirability of seed testing and describes some simple forms of apparatus that can be easily devised for testing the germination of seed. Explicit directions are given for conducting germination tests and a table of standards is provisionally offered for the leading vegetable, grain, grass, and forage-plant seeds.

Oil-producing seeds, G. H. HICKS (*U. S. Dept. Agr. Yearbook 1895, pp. 184–204, figs. 11*).—Popular notes are given on some of the more important oil-producing seeds, cotton, flax, castor bean, European spurge, sunflower, Madia, Niger seed, peanut, sesame, hemp, rape, and poppy being especially described. Methods of extraction and principal uses for the various oils are given, together with a brief account of the cultivation and distribution of the plant producing the seed.

DISEASES OF PLANTS.

What species of grass are able to infect the barberry with rust? J. ERIKSSON (*Ztschr. Pflanzenkrank., 6 (1896), No. 4, pp. 193–197*).—The author reports upon a series of inoculation experiments made in 1895 as to what species of grass were hosts for rusts that were also parasitic upon the barberry. He found that the following species were capable of serving as hosts for the barberry rust: *Agrostis stolonifera*, *A. vulgaris*, *Aira cæspitosa*, *A. flexuosa*, *Alopecurus nigricans*, *A. pratensis*, *Avena elatior*, *A. sativa*, *Bromus secalinus*, *Dactylis glomerata*, *Elymus arenarius*, *E. glaucifolius*, *Hordeum vulgare*, *Milium effusum*, *Panicum miliaceum*, *Phleum boehmeri*, *P. michelii*, *Poa chaixi*, *P. compressa*, *Secale cereale*, *Triticum caninum*, *T. repens*, and *T. vulgare*. Experiments were also conducted with negative results with *Poa pratensis*, *Triticum unicum*, *Festuca elatior*, and *Phleum pratense*, although in previous experiments the first 2 species gave positive results.

On the relation of the time of seeding and the period of development on the development of rust and smut of oats, H. L. BOLLEY (*Proc. Soc. Promotion Agl. Sci. 1896, pp. 70–75*).—A preliminary report is given of investigations by the author, in which is tabulated the percentage of rust shown by 39 varieties of oats in 1894 and 1895, from which it appears that there is a wide variation in the liability of

the different varieties to disease. It is also stated that all varieties of oats are comparatively resistant to rust until nearly the time of their flowering. With 3 varieties of rust-resistant oats there was a comparative rustiness not to exceed 5 per cent for all dates of seeding.

The difference in resistance is thought to be due in part at least to structural differences.

The *Puccinia graminis* is the variety of rust which first fails to attack the resistant oats. *P. coronata* furnishes the earliest and most persistent attack.

The cause and prevention of pear blight, M. B. WAITE (*U. S. Dept. Agr. Yearbook 1895, pp. 295–300*).—In a popular article the author gives the results of a prolonged scientific investigation on the cause and prevention of pear blight. The cause of the blight is *Bacillus amylovorus* and the life history of the organism has been worked out very carefully by means of cultures and inoculations. The blight attacks and rapidly kills the blossoms, young fruits, and new twig growth, from which it passes through the living bark to the larger limbs and finally to the trunk. The parts of the tree that are killed by the blight are the inner bark and cambium, and as a result the other parts die.

The infection takes place through the flowers, and insects serve to spread it from one cluster to another. The bacillus also gains entrance through tips of growing shoots. This form, which is the usual one in nurseries, is often called twig blight to distinguish it from the infection through the flowers, but they are both due to the same cause.

The conditions affecting the disease are numerous, and some of these may be controlled by the grower. There is a great difference in the resistance of different varieties to disease, the Duchess and Keiffer being less severely attacked than Bartlett and Clapp Favorite. Climatic conditions influence the disease to a marked degree; warm, moist conditions favoring, while dry, cool, sunny weather hinders and if protracted will check it entirely. The organism can not withstand drying at all, but is able to survive a very considerable degree of cold. It is carried over the winter in the tree to reappear in spring when the sap has begun to flow. At this time the blighted areas may be recognized by the moist and fresh appearance of the blighted bark, and a gummy exudation flows out to be visited by bees, etc., by which the disease is spread.

The treatments for the prevention of pear blight may be grouped under 2 general heads: Methods which aim to put the tree in condition to resist the disease, and those which are designed for the extermination of the bacillus. The methods under the first head must be directed toward the prevention of rapid growth since vigorous growth increases liability to disease. On this account pruning when the tree is dormant; excessive fertilizing, especially with nitrogenous manures; and cultivation are to be avoided. Where irrigation is possible, withholding water will greatly reduce the disease.

The active means suggested for preventing the disease is the extermination of the organism causing it. This consists in cutting back a few inches into the sound wood, and burning every particle of the diseased tissue while the trees are dormant. Not only must all pear trees be looked after, but all related trees, since they, too, are subject to the disease. Cutting out blighted twigs during the season is also efficient in preventing the rapid spread of the disease, but only when all traces of blighted growth has been removed will the prevention be secured.

Leaf spot of pear, G. F. Atkinson (*Garden and Forest, 10 (1897), No. 470, pp. 73, 74*).—From observations made during the past 2 or 3 years the author thinks what is usually called the leaf spot of pear is not due wholly to *Entomosporium maculatum*, but in perhaps the majority of cases is due to a different parasite. In searching fallen leaves that had lain on the ground all winter for the fungus the Entomosporium was not found, but *Sphærella sentina* and *S. pyri* were abundant. Critical examinations made of spotted leaves in a nursery during 1895 revealed in the older spots the saprophytic *Cladosporium herbarum* and *Pleospora herbarum*, while the young spots revealed abundant specimens of Septoria. The Septoria spots greatly resemble those of the Entomosporium, but a careful examination shows they are somewhat larger and inclined to become angular in outline and elongated, while the Entomosporium spots are nearly circular. Examinations made of many orchards and of much material seem to indicate that Septoria is the cause of most trouble.

The subject is to be studied further, and a request is made for material from different localities.

A rust and leaf casting of pine leaves, B. T. Galloway (*Bot. Gaz., 22 (1896), No. 6, pp. 433–453, pls. 2, figs. 3*).—The author has made an extensive study of a rust of the scrub pine (*Pinus virginiana*). This fungus, *Coleosporium pini*,[1] is rather abundant and causes considerable injury to the trees, and this paper is an important contribution to its life history.

The author summarizes his investigations as follows:

"(1) *Coleosporium pini* occurs abundantly in Maryland, Virginia, and the District of Columbia, attacking only *Pinus virginiana*.

"(2) It requires 12 months to complete the development of this fungus, and during a large part of that time it does not seriously interfere with the functions of its host.

"(3) The fungus is disseminated by means of sporidia, which develop only during wet weather.

"(4) From the leaves on which they are borne the sporidia are washed or drop to the young needles just showing their tips, which they infect. No evidence of this infection, however, is apparent for 2 or 3 months.

"(5) Regardless of the season, there is a marked similarity in the time of the appearance of the sporidia and the time of the appearance of the young leaves.

"(6) Before the fungus ruptures the cortical tissue evaporation from the diseased areas is less than that from healthy parts of the same leaf. This is due to the permanent closing of the stomata and may result in keeping the diseased parts alive longer than the healthy in case the leaf or branch is removed from the tree.

[1] Jour. Mycol., 7 (1894), p. 44.

"(7) As soon as the fungus ruptures the tissues evaporation is increased about one-fifth above the normal. In consequence of this the reserve water in the cells is gradually used up. This is followed by loss of turgidity and other physiological changes which lead to the gradual death and casting of the leaves."

The effectiveness of corrosive sublimate as a preventive of potato scab, H. L. BOLLEY (*Proc. Soc. Promotion Agl. Sci. 1896, pp. 75–81, fig. 1*).—The author reports a series of investigations undertaken on account of the criticism[1] "that the corrosive sublimate treatment is ineffectual against scab when tested in connection with soil fertilized with lime and other alkaline engendering agents."

The first experiment was made in a greenhouse, the potatoes being grown in boxes containing virgin prairie subsoil. The seed tubers were scabby and had been treated by soaking in varying strengths of corrosive sublimate solutions. No contamination could have taken place except through the use of tap water. The soil received various quantities of lime, and when the crop was dug all the tubers were washed and thoroughly inspected. All were practically free from scab, the lime having had no effect in increasing the disease.

In the field trial the soil had not recently grown potatoes, although fields adjoining on 2 sides had been planted to potatoes 2 seasons previous and high winds had drifted considerable dust over the trial plat resulting, as it proved, in a very thorough contamination. The seed tubers were treated and the soil received lime in varying amounts. The tubers dug from all the rows were more or less scabbed, from 10 to 20 per cent being the lowest per cent affected. In the check rows where the tubers had received no preliminary treatment about 98 per cent were diseased. It is said that the addition of lime gave no increase in scabbiness. The soil at the station is considered sufficiently alkaline for the growth of the fungus. The author thinks it probable that in acid soils where there is chance for infection the addition of lime would be undesirable.

A limited test made with flowers of sulphur for the prevention of scab indicated that the substance was without effect in preventing the development of the fungus.

Potato scab, H. J. WHEELER and G. M. TUCKER (*Rhode Island Sta. Bul. 40, pp. 80–96, figs. 4*).—The authors, in continuation of their previous work[2], have again investigated the effect of various substances in increasing or decreasing the amount of scab on potatoes when grown under different conditions of treatment.

The effect of sodium chlorid, sodium carbonate, and oxalic acid upon the development of scab on tubers when grown with the aid of barnyard manure was investigated by means of pot experiments. The results confirmed those of the previous year and indicate that under the conditions of the experiment common salt tends to decrease the amount of scab and sodium carbonate to increase it. Oxalic acid

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[1] Rhode Island Sta. Bul 33 (E. S. R., 7, p. 782).

[2] Rhode Island Sta. Bul. 30 (E. S. R., 6, p. 906) and Bul. 33 (E. S. R., 7, p. 782).

decreases scab when used with barnyard manure, especially when used in conjunction with salt.

The influence exerted by various calcium compounds on scab development was investigated and the results obtained are tabulated. From these it appears that the chlorid and sulphate nearly or quite prevented scab, although the first greatly reduced the yield. The carbonate, oxalate, and acetate of sodium, air-slacked lime, and wood ashes tended to increase greatly the amount of badly scabbed tubers. The unlimed pots gave a product without scab.

In this series of experiments the seed tubers were soaked for 1½ hours in a 1:1000 per cent solution of corrosive sublimate prior to planting. In the pots which were badly infested with the fungus causing the scab and in which the conditions were favorable for its growth the treatment was considered useless.

The authors review some of the investigations of Halsted[1] relative to the efficiency of sulphur in combating potato scab. They conducted some experiments to test the value of this fungicide for use against the scab fungus. In these experiments sulphur at the rate of 600 lbs. per acre was thoroughly worked into the first 7 or 8 in. of the soil in the pots; where the soil was contaminated and the conditions favorable for the growth of the fungus the crop was practically destroyed by scab and in 2 instances no advantage seemed to have followed from its use. The authors think that if sulphur was not efficient when used to the extent of 600 lbs. per acre, smaller quantities broadcasted or in the drills would prove of little or no value. The expense of sulphur when applied in such large quantities would prove a serious obstacle to its use while the market value of potatoes remains as low as at present.

Experiments for the prevention of potato scab, T. A. WILLIAMS (*South Dakota Sta. Bul. 48, pp. 1–11*).—A report is given of experiments with corrosive sublimate, Bordeaux mixture, and eau celeste for the prevention of potato scab. The results are tabulated, from which it is seen that—

"(1) Seed treated with corrosive sublimate will give a product practically free from scab if planted in uninfested land.

"(2) Thorough treatment will very materially reduce the amount of scab when the seed is planted in infested land.

"(3) There seems to be very little difference in the effectiveness of the different solutions of corrosive sublimate used, so long as the time of immersion is kept proportionate to the strength of the solution. More care is necessary, however, in using the stronger solutions.

"(4) In immersing it is best to treat the seed before cutting.

"(5) Eau celeste and Bordeaux mixture are both effective against the scab fungus, but both seem to affect the yield more or less.

"(6) In the infested land spraying was quite as effective as immersing when Bordeaux mixture or the stronger solutions of corrosive sublimate are used. It must be remembered, however, that the seed used was quite free from scab.

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[1] New Jersey Stas. Bul. 112 (E. S. R., 7, p. 780).

"(7) It seems that the thicker skinned, darker colored varieties are better able to resist the attack of the disease.

"(8) Potatoes should not be allowed to remain in the ground long after ripening, especially if the season is wet."

Fungiroid as a preventive of potato rot, H. P. GOULD (*Maine Sta. Rpt. 1895, pp. 78, 79*).—A test was made of Fungiroid, which is claimed to be a powdered Bordeaux mixture and a substitute for that fungicide as ordinarily prepared. In order to test the efficacy of this fungicide a plat containing 18 rows of potatoes was treated in the following manner: The first row was sprayed with Bordeaux mixture, Fungiroid was applied to the next, while the third was left untreated to serve as a check. This order of treatment was preserved throughout the plat, there being in all 6 rows sprayed with Bordeaux mixture, 6 treated with Fungiroid, and 6 checks. The first application of the fungicide was made July 13, and 2 other applications were given at intervals of about 2 weeks.

The following table gives a summary of the experiments:

Bordeaux mixture vs. fungiroid.

Treatment.	Total weight.	Ratio of yield.	Weight of decayed tubers.	Decayed tubers.
	Pounds.		*Pounds.*	*Per cent.*
Bordeaux mixture	$262\frac{3}{4}$	1.00	1.1	0.4
Fungiroid	219	.83	18.7	8.5
Check	$198\frac{3}{4}$	.75	20.3	10.2

From the above table it may be seen that Fungiroid, while slightly increasing the yield of potatoes over that of the checks, seemed of little value as a preventive of the disease.

Glœosporium myrtilli on Vaccinium myrtillus, G. WAGNER (*Ztschr. Pflanzenkrank., 6 (1896), No. 4, pp. 198, 199*).—Notes are given of this new fungus described by Allescher. It seems very injurious to its host.

Note on Ustilago esculenta, K. MIYABE (*Bot. Mag., 9 (1895), No. 99; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 4, p. 235*).—Notes are given of this fungus which attacks *Zizania latifolia*, producing edible forms.

Bacterial gummosis of sugar beets (*Döring Blatt. f. Zuckerrübenbau, 1896, pp. 17–20; abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 5, p. 296*).

A new remedy for potato scab (*Amer. Gard., 18 (1897), No. 116, p. 178*).—Editorial mention is made of the successful use by J. C. Arthur, of the Indiana Station, of formalin as a preventive of scab. The seed tubers are soaked for 2 hours in a solution of 8 oz. in 15 gal. of water.

Concerning the causes of potato rot, FRANK (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 2–3, pp. 57–59; also Deut. landw. Presse, 24 (1897), No. 16, pp. 134, 135*).

Diseases of potatoes and preventive treatment, L. VANDENBERCH (*Belg. Hort. et Agr. 9 (1897), No. 5, pp. 68, 69*).

Celery diseases in the South (*Florida Agr., 24 (1897), No. 10, p. 145*).—Various diseases of celery are described, and the use of a weak solution of carbonate of copper is recommended for their prevention.

On the influence of fumes on black rot, E. MARRE (*Prog. Agr. et Vit., 27 (1897), No. 10, pp. 292–294*).

Concerning the cutting bed fungus and its prevention, R. ADERHOLD (*Gartenflora, 46 (1897), No. 5, pp. 114-126, fig. 1*).

A gum disease of the cacao tree, L. MANGIN (*Compt. Rend., 124 (1897), No. 6, pp. 312-315; also Jour. Agr. Prat., 61 (1897), No. 8, pp. 274, 275, figs. 2*).

Bacteriosis of the mulberry tree, V. PEGLION (*Centbl. Bakt. und Par Allg., 3 (1897), No. 2-3, pp. 60-64*).

Preventive treatment of grape anthracnose, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 7, pp. 173, 174*).—Winter treatment with weak solutions of sulphuric acid or acid solutions of iron sulphate are recommended.

The black rot of grapes, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 6, pp. 145-148*).—The value of copper compounds and resistant stock is shown.

Club root in roses, B. T. GALLOWAY (*Amer. Gard., 18 (1897), No. 113, p. 127*).—Notes are given of injury to roses by nematodes and the sterilization of the soil by steam heat wherever practicable is advised.

An injurious parasite of the Japanese forests, HOUDA (*Forstl. naturw. Ztschr., 6 (1896), No. 1, pp. 36, 37, fig. 1*).—*Helicobasidium monipa* is described.

Fungus diseases of agricultural and forest culture plants in Hanover during 1896, C. WEHMER (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 24-25, pp. 780-797*).

Forest fungi, B. D. HALSTED (*Forester, 2 (1897), No. 2, p. 25*).—Notes are given on cedar apples and their connection with diseases of apples and pears.

Report on experiments in the prevention of heart and dry rot of sugar beets in 1896, FRANK (*Ztschr. Ver. Rübenz. Ind., (1896), Dec., pp. 901-928, fig. 1*).

Potassium sulphid for peach mildew, J. W. HOUCK (*Pacific Rural Press, 53 (1897), No. 11, p. 166*) —Spraying trees with a solution of ½ oz. of potassium sulphid in 5 gal. of water is said to be an efficient remedy against the powdery mildew of peach.

Bordeaux mixture for peach leaf curl, N. P. CHIPMAN (*Pacific Rural Press, 53 (1897), No. 6, p. 84*).—A Bordeaux mixture composed of 5 lbs. each of copper sulphate and lime to 50 gal. of water is said to be very efficient in preventing leaf curl.

Preventives against carnation rust, H. WEBER (*Florists' Exchange, 9 (1897), No. 6, p. 130*).

Nitrate of soda to kill eel worms, J. N. MAY (*Amer. Florist, 12 (1897), No. 459, pp. 770, 771*).—Reports negative results with nitrate of soda even when used as strong as 1 oz. to 4 gal. of water.

Fungus diseases and injurious insects, R. H. PRICE (*Texas Sta. Bul. 39, pp. 840-847, figs. 9*).—Popular notes are given on the black spot of peach, root galls, nematode affections, curculio, brown or black root aphides, leaf footed bug (*Leptoglossus phyllopus*), and peach tree borer, and as far as known the best remedies suggested for combating their attacks.

Concerning the injury done in 1894 by fungi and insects in Prussia, P. SORAUER (*Ztschr. Pflanzenkrank., 6 (1896), Nos. 4, pp. 210-225; 5, pp. 277-285; 6, pp. 338-342*).—A review is given of the diseases and insects injuring various crops and statistical estimates are given of the amount of injury done.

ENTOMOLOGY.

Three injurious insects, T. A. WILLIAMS (*South Dakota Sta. Bul. 48, pp. 12-20, figs. 5*).—Notes are given of the box elder twig gall moth, a web spinning sawfly of plums and cherries, and the wheat stem maggot.

Illustrated descriptive notes are given of the box elder twig gall moth (*Proteopteryx spoliana*), an insect that has proved troublesome to the box elder trees for some time. There are claimed to be 2 broods, the second generation passing the winter in the ground. Spraying the

trees with arsenites immediately after the eggs begin to hatch, and cutting out and burning all twigs that have been bored are the means suggested for its destruction. At least 2 species of hymenopterous parasites, one of which occurs in considerable abundance, have been bred from this insect.

The web spinning sawfly of plums and cherries is figured and described. The insect which was submitted to the Division of Entomology of this Department was named *Lyda rufipes*, n. sp., and described by C. L. Marlatt as follows:

"*Female.*—Length, 11 mm.; expanse, 18 mm.; robust, flattened; head very coarsely rugosely punctured; thorax with more scattered and finer punctures, shiny; abdomen very finely shagreened; anterior tibiæ without side spur; cross vein of medium cell very rudimentary, scarcely projecting one-third width of cell; antennæ 21 jointed, third joint three times as long as fourth; claws rather deeply and finely notched; color black, shining; mandibles and legs for the most part reddish-yellow; extreme tip of posterior tibæ, and all tarsi, except base of metatarsal joint of fore and middle legs, brownish black; elongate spot on center of clypeus, spot at base of mandible, and at upper inner angle of compound eyes, together with the tegulæ and base of wings, whitish-yellow; wings nearly hyaline, nervures, including stigma, dark brown, almost black; a very slight smoky shade obscures outer half of both wings.

"Male agrees with female in structural and colorational features, but is one-fifth smaller."

The mature insect usually appears about the second week in June. The eggs are laid in close masses along the mid rib of the younger leaves. Immediately upon hatching the young larvæ begin to spin a web and feed, traveling from leaf to leaf, enveloping all in a web. When ready to pupate the larvæ descend to the ground, whence they emerge the next year. Spraying with arsenites is recommended as the best treatment.

The wheat stem maggot or American meromyza (*Meromyza americana*) is figured and briefly described and economic notes are given on its habits and treatment. The figures and descriptions are from Minnesota Sta. Bul. 43 (E. S. R. 8, p. 146).

Green fruit worms, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 123, pp. 509–522, pls. 4*).—This bulletin treats of the noctuids, *Xylina antennata*, *X. laticinerea*, and *X. grotei*. During the year 1896 these insects did considerable damage to young fruits, especially apples, in 5 counties in the northwestern section of the State. "It was estimated that at least 25 per cent of the apple crop was injured in many localities. . . . It was found that the caterpillars fed during the day and probably also at night. When young, they doubtless feed upon the foliage or buds, for when the fruit is large enough for them to eat the worms are half grown or more."

They were found apparently resting during the day on the silken web spun on one side of the partly rolled leaf. The author suspects that this is not a normal habit of the insects, for the only occasion on which it was seen to be resorted to in his cages was in the case of a caterpillar suffering from a serious internal trouble caused by a parasitic grub.

In all previous discussions of an economic nature regarding these green fruit worms, the author says, they have been considered as comprising but a single species of insect (*Xylina antennata*), but after specimens of the caterpillars began to arrive at the insectary, it was found that there were 2 distinct species; and later it was determined that there were 3 species.

About three-fourths of the green fruit worms sent to the insectary were *X. antennata*. *X. laticinerea* was represented among specimens received from each locality and in one or two instances it seemed to be as numerous as the preceding species. Concerning the earlier stages of the *X. laticinerea* it is observed that the caterpillars appear in May, that pupation takes place in earthen cells in June, that the caterpillars form no trace of a cocoon, and that the pupa state continues until fall, when the moths emerge from some of them. In the insectary, most of the pupæ were hibernating at the time of writing (December). One moth emerged September 26. From recorded captures it appears that the moths of this species fly in the fall and spring, many of them doubtless hibernating, and others not emerging until spring.

X. grotei formed but a small percentage of the worms sent in.

Among the natural enemies of these worms the author notes the red-winged blackbird and the hymenopterous parasites, *Meteorus hyphantriæ*, *Hyphantria cunea*, and *Mesochorus agilis*. Twenty-six half-tone illustrations are given of the moths, larvæ, pupæ, and parasites of these insects.

For combating these pests, spraying with Bordeaux mixture and Paris green before the blossoms open, cultivation of the orchards during July and August while the worms are in the ground undergoing their transformations, and jarring the worms from the tree into sheets, are recommended.

The principal insect enemies of the grape, C. L. MARLATT (*U. S. Dept. Agr. Yearbook 1895, pp. 384–401, figs 12*).—Nine of the 100 different insect enemies known to affect the grapevine in this country are here treated. These 9, the phylloxera (*Phylloxera vastatrix*), the fidia (*Fidia viticida*), the cane borer (*Amphicerus bicaudatus*), the flea beetle (*Haltica chalybea*), the rose chafer (*Macrodactylus subspinosus*), the grape leaf folder (*Desmia maculalis*), the grape leaf hopper (*Typhlocyba vitifex*), and the grape berry moth (*Eudemis botrana*), are practically the most important.

Of these the phylloxera is very fully described. The usual remedies, such as the use of bisulphid of carbon, flooding the vineyard, and planting in sandy soil, are noted at some length, as is also the use of resistant stocks, such as æstivalis, riparia, and labrusca.

The fidia, the author says, is best treated by means of an arsenical spray with lime used in the customary way of 1 lb. to 150 gal. of water. The larvæ feeding around the roots may be killed by wetting the soil around the vine with kerosene emulsion before they have scattered, or by injecting bisulphid of carbon as in the case of the phylloxera.

Concerning the rose chafer little is said further than to advise the planting of decoy plants near the vineyard. He adds that the numbers of the insect may be restricted by limiting their feeding areas, such as sandy meadow lands. These should be planted with annual crops.

Since the use of poisons in the case of the berry moth is dangerous it is advisable to destroy all infested fruit.

The shade tree problem in the United States, L. O. HOWARD (*U. S. Dept. Agr. Yearbook 1895, pp. 361–384, figs. 11*).—In the first portion of this paper the bagworm (*Thyridopteryx ephemeræformis*), the imported elm leaf beetle (*Galerucella luteola*), the white marked tussock moth (*Orgyia leucostigma*), and the fall webworm (*Hyphantria cunea*), are discussed. Although a few other insects do more or less damage, the author considers these the most injurious of the eastern shade-tree insects. To the imported elm leaf beetle and the white marked tussock moth considerable space is given, the history, distribution, and remedies against the insects being discussed. Some details relative to the external anatomy of the larvæ of the tussock moth are described.

As remedies against the imported elm leaf beetle, spraying with an arsenical solution is thought the best, and in fact the only thorough safeguard. The size of the tree need form no obstacle, for recent experiments have demonstrated that spraying is applicable even to the largest. The only other remedy worth noting is the destruction of the larvæ in the ground before their pupation, by spraying or other means. In spraying care should be taken that the ground beneath the entire limb-spread and the lower crotches of large trees are reached. Sometimes it may be advantageous to remove the rough bark from the tree-trunk.

As regards the tussock moth, 2 classes of remedies may be employed to advantage: (1) Either the eggs may be gathered in winter or destroyed by the use of a mixture of turpentine and creosote applied to the egg clusters with a sponge at the end of a pole; or (2) the larva may be attacked in their season by spraying and by the use of bands of raw cotton or of insect lime. The last measure is especially good for this species, since it is the only one of the shade tree insects in which the female is wingless, thus rendering it necessary for the insect to spread from tree to tree by the migration of its larvæ.

The fall webworm, which, according to the records of the Division of Entomology, is known to feed upon 120 shade and ornamental trees, may be disposed of by pruning, by burning the webs at nightfall, and, in the case of city trees, by the application of arsenical sprays. Collecting the egg masses in winter along with those of the white marked tussock moth is also recommended.

In the second portion of the work the author treats the question as to what can be efficiently and economically done by city governments or in their failure to act, by citizens who are interested in the preservation of shade trees do. He contends that if the planting of shade trees

is a public matter, their care should be a public duty. To reduce the expense of applying emulsions, etc., he advises city authorities to transfer discarded fire engines to the use of those caring for shade trees.

In the third portion of the paper a table is given showing the relative immunity to insect attack of 36 common shade and ornamental trees. The ginkgo and tulip tree seem to be the most immune. The sugar maple, red oak, ailanthus, scarlet oak, yellow oak, willow oak, black maple, Japanese sophora (all of equal rank) stand next; while cottonwood, balm of gilead, European elm, black locust, and box elder stand lowest.

Recent observations on Sesamia, lepidoptera injurious to maize, sugar cane, sorghum, etc., J. K. D'HERCULAIS (*Compt. Rend.*, *124* (*1897*), *No. 7*, *pp. 373–376*).—The author has made some new observations on the autumn-winter generations of *Sesamia nonagrioides*, previously noted as the cause of considerable damage to maize, sorghum, and other large Gramineæ in Algiers (E. S. R., 8, p. 507). The low temperature at night, often freezing water during December and January, does not noticeably retard the development of the insect. The imagos emerge all through these months, and upon the stalks of maize may be found numerous larvæ of all ages, ranging from 10 to 12 mm. to 18 to 20 mm. and to the size of the adult larvæ, 30 to 35 mm. From these facts the author concludes that the insect was probably originally a native of a climate sufficiently warm to allow its life process to continue throughout the year, and that it has been introduced into Algiers and other Mediterranean countries. Its distribution is, he thinks, a result of the extension of the culture of sugar cane by cuttings.

A notable occurrence of the oak scale (Lecanium quercus) in connection with a flow of sap, BRECHER (*Forstl. naturw. Ztschr.*, *6* (*1897*), *No. 2*, *pp. 66–69*).—The author describes the method of attack of this insect and a consequent emission of sap that collects about the insects and forms a nidus for the development of other insects and of fungi. The diseased spots penetrate the bark to the old wood fiber, and emit an intense odor. The collected sap contains numberless nematodes, which may be *Anguillula aceti*, and from May to July and later many little flesh colored larvæ, about 2 to 3 mm. long that in August transform to *Cryptarcha strigata*. The larvæ of *Sarvonia grisea*, *S. punctatissima*, *Cis boleti*, *Amphotis marginata*, and *Epuræa decemguttata* are are also found, as well as the larvæ of flies. The sap evidently ferments, producing alcohol, for many wasps, bees, and beetles found drinking the liquid soon evince signs of drunkenness.

Among a number of remedies tried, including carbolic acid and soap, lime, ammonia, and cutting out the diseased spot, only the last proved successful.

Report of the entomologist, F. L. HARVEY (*Maine Sta. Rpt. 1895*, *pp. 89–126*, *pls. 2*, *figs. 3*).—A résumé is given of the some important entomological work of the year, together with some detailed accounts

of cattle lice, the spotted paria or strawberry leaf beetle, and the currant and gooseberry fruit fly. Brief notes are given on the yellow woolly bear (*Spilosoma virginica*) which is reported as attacking raspberry leaves, on the tapestry moth (*Tinea tapetzella*), and on the cucumber flea-beetle (*Crepidodera cucumeris*), with directions for combating their injuries.

The author figures, describes, and suggests remedies for the following 3 species of cattle lice: Short nosed ox louse (*Hæmatopinus eurysternus*), the long nosed ox louse (*H. vitula*), and the biting louse of cattle (*Trichodectes scalaris*). The use of various powders, unctions, liquids, and fumes is recommended and methods of treatment are described.

The spotted paria or strawberry leaf beetle (*Typophorus canellus gilvipes*) is reported as attacking raspberry buds, causing serious injury. The life history and description of the insect, together with some correspondence relating to its appearance and treatment, are given. The use of arsenites, handpicking, and the destruction of all rubbish are recommended as preventive and remedial measures. It would seem from the correspondence that Paris green was not wholly successful in destroying the pest. In this case emulsions or repellents should be employed.

The most important work of the year was a study of the life history of the currant or gooseberry fruit fly (*Epochra canadensis*). The author reviews some of the literature referring to this insect and gives in considerable detail its history, life history, and the remedies suggested.

The general description is as follows:

"Perfect insect, a 2-winged fly about the size of a house fly. Pale yellow or orange with greenish iridescent eyes and dark bands across the wings. Found about currant and gooseberry bushes during June in Maine. Stings the currants, depositing an egg under the skin that hatches and develops into a small white maggot, causing the fruit to turn red and drop prematurely. The maggots when grown leave the fallen or hanging fruit, enter the ground, change to a pupa state from which the fly emerges the following June."

The premature falling of the fruit in which the worms usually remain for some time suggest the destruction of the former as a possible means of greatly restricting the number of the insects; mulching about the bushes will also aid in keeping the fly in check. Other means are suggested of greater or less practicability. So far as known there are no parasites to keep the pest in check.

Apiculture simplified, A. BAFFERT (*Bol. Agr., Mineria é Industrias, Secretaria de Fomento, Mexico, 6 (1896), No. 2, pp. 135–139*).

Tsetse fly disease in Zululand (*Amer. Micros. Jour., 17 (1897), No. 11, pp. 394–396*).—Abstract from the *London Lancet*.

Life history of larvæ of Œstrus, RUSER (*Centbl. Bakt. und Par., 20 (1896), p. 548; abs. in Jour. Roy. Micros. Soc., 1897, I, p. 32*).—The transparent larvæ of the fly were found in 4 oxen in the loose connective tissue between the æsophagus and

the body wall. The larvæ, therefore, appear to gain an entrance through the mouth of the animal.

Parasitic beetles, G. BRANDES (*Centbl. Bakt. und Par., 20 (1896), pp. 297–305; abs. in Jour. Roy. Micros. Soc., 1897, I, pp. 31–32*).—Refers to the coleopterous beaver parasite (*Platypsyllus castoris*).

The Rocky Mountain locust and its allies in Canada, S. H. SCUDDER (*Rpt. Ontario Ent. Soc., 1895, pp. 62–66, figs. 2*).

Locusts in Buenos Ayres (*Weekly North Western Miller, 43 (1897) No. 11, p. 387*).—It is reported that the Congress of Buenos Ayres has appropriated $700,000 to be divided among the provinces of Santa Fé, Entre Rios, and Cordova, which have suffered severely from locust invasion and drought, and to be used for furnishing seed for the colonists who have lost everything. The Congress has also appropriated $400,000 for the scientific study of the insects and to learn their haunts. They are supposed to winter in the Grand Chaco. A committee of leading merchants has also been formed to deal with the subject, and subscriptions have been collected with a view to employing some well-known entomologists.

Insect enemies of coffee, J. C. KONIGSBERGER (*Abs. in Ztschr. Pflanzenkrank., 6 (1896), No. 5, pp. 290, 291*).—Notes are given of *Lecanium viride, L. coffeæ, Aphis coffeæ, Teras hecabe, Cyclopelta obscura*, and *Batocera hector*.

Insects injurious to apple trees, P. BROCCHI (*Rev. Hort., 69 (1897) No. 5, pp. 107–111, col. pl.*).—Seventy-two insects are noted. Of these only 12 are seriously injurious.

The orange fruit worm, S. BAXTER (*Garden and Forest, 10 (1897), No. 473, p. 108*).—The author thinks it would be unfair to impose a prohibitory tariff on Mexican oranges, and that the Mexican Government should take steps to destroy the pest.

The orange fruit worm, J. B. SMITH (*Garden and Forest, 10 (1897), No. 473, p. 108*).—A note advocating the establishment of a national quarantine against this insect.

The white fly (*Florida Farmer and Fruit Grower, 9 (1897), No. 1464, p. 131*).—A series of five letters referring to the occurrence of the white fly in an orange grove. The trees were saved from freezing during the severe winter of 1895, and along with them a great number of white flies, which are now on the trees in masses. The writers think it advisable for the trees to be bought by interested persons and burned.

The plum curculio, W. G. JOHNSON (*Amer. Gard., 18 (1897), No. 116, p. 174, fig. 1*).—Popular notes on this insect, with suggestions for its control.

The strawberry root louse (Aphis forbesi), G. H. PAMELL (*Garden and Forest, 10 (1897), No. 472, pp. 93, 94*).—Advises rotation of crops to starve out the insects. Easily treated with carbon bisulphid, kerosene emulsion, or tobacco water.

The grape louse and its destruction (*Würt. Wochenbl. Landw., 1897, Nos. 4, pp. 46–48; 5, pp. 62–64; 6, pp. 80–82*).—This discusses the phylloxera (*Phylloxera vastatrix*), its habits and life history, remedies against it, and the history of its occurrence and damages in all parts of the world.

The use of mustard for wireworms (*Gard. Chron., ser. 3, 21 (1897), No. 532, p. 160*).—Advocates dusting ground mustard about trenches, etc., where plants are to grow as a means of destroying the worms. One hundred worms were placed in a cup and powdered with mustard and in 10 minutes all were dead. It must not be used too freely as it will also injure some plants.

Notes on forest insects, NITSCHE (*Tharand forst. Jahrb., 46 (1896), II, pp. 225–247, pl. 1, figs. 2*).—*Phyllobius psittacinus, Cneorrhinus plagiatus, Scolytus intricatus, Cerambyx scopalii, Liparis dispar, Cnethocampa pityocampa, C. pinivora*, and *C. herculeana*. The manner of leaf feeding of *Phyllobius psittacinus* is noted and compared with that of certain Chrysomelidæ and of lepidopterous larvæ, with an endeavor to show that the species of insect can be determined from its manner of feeding. The report of the work of destroying the gypsy moth, by Forbush and Fernald, is reviewed at length and exception taken to the use of the generic term Porthetria instead of Liparis of

Ochsenheimer. Some few facts are also given as to the occurrence of and the damage done by *L. dispar* in Bulgaria during 1892–'93. The form of the mandible of the larva and the form of the egg cylinders of the 3 speciès of Cnethocampa are described and figured.

How the forest in the District of Bedford was swept away, T. W. FYLES (*Rpt. Ontario Ent. Soc., 1895, pp. 21–25, figs. 6*).—Besides the forest fires the work of insects, especially that of borer beetles, is noted as a devastating agent.

Some winter insects from swamp moss, W. H. HARRINGTON (*Rpt. Ontario Ent. Soc., 1895, pp. 47–53*).—Notes on the wintering of insects in moss, with lists of species found.

Quarantine against destructive insects and plant diseases (*Garden and Forest, 10 (1897), No. 472, pp. 91, 92*).—The orange worm (*Trypeta ludens*) is especially referred to as an insect against which action should be taken, and the case of the Morelos orange worm cited to show what such an insect might do should it once gain entrance into the country.

Insect injuries of the year 1895, J. FLETCHER (*Rpt. Ontario Ent. Soc., 1895, pp. 31–36, figs. 9*).—Notes on the insects affecting cereals, roots, fodder plants, and fruits.

Injurious foreign insects, a constant menace to American horticulture (*Florida Farmer and Fruit Grower, 9 (1897), No. 10, pp. 147, 148*).—Extracts from an essay by T. D. A. Cockerell on the rapid spreading of scale insects, etc.

Observations on the season of 1895, J. MOFFAT (*Rpt. Ontario Ent. Soc., 1895, pp. 38–41, figs. 5*).—Devoted entirely to notes on butterflies and moths.

Inspection of Paris green, W. C. STUBBS (*Louisiana Stas. Bul. 45, 2d ser., pp. 80–84*).—The text of the law providing for the inspection of Paris green is given and analyses of 8 samples of this material are reported.

Variation, with special reference to insects, J. A. MOFFAT (*Rpt. Ontario Ent. Soc., 1895, pp. 41–47*).

Wasps, J. CAMPBELL (*Trans. Nat. Hist. Soc. Glasgow, 4 (1896), pp. 265–267; abs. in Jour. Roy. Micros. Soc., 1897, I, pp. 29, 30*).

New and little-known Carabidæ, L. GAUGLBAUER (*K. K. zool. bot. Ges. Wien, 46 (1897), No. 10, pp. 457–467*).—*Trechus* (*Anophthalmus*) *dietli*, n. sp.; *T. brandisi*, n. sp.; *T.* (*Anophthalmus*) *paganetti*, n. sp.; *Æchmites stussineri*, n. sp.; *Tapinopterus kaufmani*, n. sp.; and *T.* (*Percosteropus*) *byzantinus*, n. sp., are described.

Catalogue of the described Coleoptera of Australia, II, G. MASTERS (*Proc. Linn. Soc. N. S. Wales, 21 (1896), No. 81, pp. 49–108*).

On the phylogeny and evolution of the Lepidoptera from a pupal and oval standpoint, D. T. A. CHAPMAN (*Trans. Ent. Soc. London, 1896, IV, pp. 567–589*).

The usefulness of the Braconidæ in the domain of forestry, DOLLES (*Forstl. naturw. Ztschr., 6 (1897), No. 1, pp. 1–7*).

The probable origin and diffusion of North American species of the genus Diabrotica, II, F. M. WEBSTER (*New York Ent. Soc. Jour., 4 (1896), No. 2, pp. 67, 68*).

Diabrotica in New Mexico, T. D. A. COCKERELL (*New York Ent. Soc. Jour., 4 (1896), No. 4, p. 201*).—Corrects some errors in a paper by F. M. Webster.

The North American species of Nemobius, S. H. SCUDDER (*New York Ent. Soc. Jour., 4 (1896), No. 3, pp. 99–107*).

On the classification of three subfamilies of moths of the family Pyralidæ, the Epipaschiinæ, Endotrichinæ, and Pyralinæ, G. F. HAMPSON (*Trans. Ent. Soc. London, 1896, IV, pp. 451–551, figs. 84*).

The leaf-cutting of the species of Megachile, K. SAJO (*Ill. Wochenschr. Ent., 1 (1896), No. 37, pp. 581–584, figs. 2*).

A short review of the Chrysomela of North America, M. L. LINELL (*New York Ent. Soc. Jour., 4 (1896), No. 4, pp. 195–200*).

Preliminary handbook of the Coleoptera of Northeastern America, H. F. WICKHAM (*New York Ent. Soc. Jour., 4 (1896), No. 1, pp. 33–49*).

The action of different gases and vapors on the ova of insects, E. PERRONCITO and G. BOSSO (*Giorn. R. Acc. Naz. Veterin., 44 (1895), pp. 297–301; abs. in Zool.*

Centbl., 4 (1897), No. 1, pp. 25, 26).—The action of the chlorin and bromin gases on the eggs of *Bombyx mori* was studied. The eggs were placed under bell jars. Chlorin gas allowed to act for 12 hours lessened the number of larvæ; allowed to act for 24 hours it killed the eggs. Bromin acted more quickly, an exposure of the eggs to it for half an hour killing all. Carbon bisulphid has the same effect after 15 to 24 hours. Sulphuric acid vapor acts with the same result in 1 to 2 hours. Illuminating gas does not give this result within 48 hours, and carbon dioxid does so only after 5 days. Eggs placed in vacuo begin to suffer from the second day.

The brain of the bee: A preliminary contribution to the morphology of the nervous system of the Arthropoda, F. C. KENYON (*Jour. Comp. Neurology, 6 (1896), pp. 133–210, pls. 9; abs. in Science, 5 (1897), No. 113, p. 358, and Jour. Roy. Micros. Soc., 1897, I, p. 29*).—The various tracts of fibers connecting the optic lobes, the antennal lobes, and the ventral nervous system with the mushroom bodies of the central portion of the brain, as well as with other portions, are described and figured. The cells composing the mushroom bodies are thought to form the intellective centers of the bee's brain.

Larval gills of Odonata, G. GILSON (*Jour. Linn. Soc. London, 25 (1896), pp. 413–418, figs. 3; abs. in. Jour. Roy. Micros. Soc., 1897, I, pp. 30, 31*).

Thoracic glands in larvæ of Trichoptera, G. GILSON (*Jour. Linn. Soc. London, 25 (1896), pp. 407–412, figs. 2; abs. in Jour. Roy. Micros. Soc., 1897, I, p. 30*).

Gizzards of Odonata, F. BLIS (*Zool. Jahrb. Abth. Syst., 9 (1896), pp. 596–624, figs. 14; abs. in Jour. Roy. Micros. Soc., 1897, I, p. 31*).—The Calopteriginæ are considered as representing the primitive form and the Libellulinæ the highest. Sixteen longitudinal toothed areas in the former are reduced in the latter to two pairs of teeth bilaterally situated.

Literature on defensive and repugnatorial glands of insects, A. S. PACKARD (*New York Ent. Soc. Jour., 4 (1896), No. 1, pp. 26–32*).

Notes on the transformations of higher Hymenoptera, I, A. S. PACKARD (*New York Ent. Soc. Jour., 4 (1896), No. 4, pp. 155–166*).

Metamorphoses of beetles, XAMBEU (*Ann. Soc. Linn. Lyon, 41 (1894), pp. 107–156; 42 (1895), pp. 53–100; abs. in Jour. Roy. Micros. Soc., 1897, I, p. 29*).—In his fifth memoir on the subject this author describes the metamorphoses of numerous families of beetles with a view toward a better classification and to aiding in the formation of better ideas of their economic importance.

The growth of the wings of the Luna moth, J. A. MOFFAT (*Rpt. Ontario Ent. Soc., 1895, pp. 36–38, figs. 2*).

The value of entomology, J. FLETCHER (*Rpt. Ontario Ent. Soc., 1895, pp. 16–21, figs. 4*).—A general survey of economic entomology, with mention of some of the common injurious pests, such as the fluted scale (*Icerya purchasi*), the clover midge, etc.

The entomological laboratory of the state agricultural institute at Gembloux, 1896, M. POSKIN (*Bul. Agr. (Bruxelles), 12 (1896), No. 6, pp. 199–216, figs. 10*).—A report on several of the common destructive insects of France, discussing injuries, habits, etc., and pointing out the critical periods in the life history of the insects, thus indicating the most favorable season for attempting to destroy them. The plum fly (*Aphis pruni*), *Liparis chrysorrhea, L. dispar, Bombyx neustria, Scolytes pruni, S. ruglosus, Phratora vitellinæ, Calocoris bipunctatus, Mamestra brassicæ, Aleurodes chelidoni,* and *Ptilinus pectinicornis* are treated.

FOODS—ANIMAL PRODUCTION.

On the behavior of coal-tar colors toward the process of digestion, H. A. WEBER (*Jour. Amer. Chem. Soc., 18 (1896), No. 12, pp. 1092–1096*).—Experiments were conducted to determine the probable effects on digestion of coal-tar colors commonly used by confectioners.

Oroline yellow, known in the trade as "fast yellow" or "acid yellow," was found to seriously retard the artificial digestion of blood fibrin in pepsin solution. Saffoline, or "acridine red," and magenta were found to have no effect upon the digestion with pepsin, but had a marked effect in retarding the digestion of fibrin with pancreatin, while oroline yellow had none. Methyl orange behaved like saffoline and magenta.—F. W. MORSE.

A contribution to the study of Southern feeding stuffs, J. B. McBryde (*Tennessee Sta. Bul., Vol. IX, No. 3, pp. 51–164*).—The first part of this bulletin contains reports of analyses made at the Tennessee Station of a large number of Southern feeding stuffs. The author gives a description of the samples, and in most cases the minimum, maximum, and average composition of the following: Cotton-seed meal, decorticated cotton-seed meal, cotton-seed cake, cotton-seed hulls, cotton-seed hull bran, peanut cake, wheat bran, wheat middlings, wheat shorts, unbolted corn meal, prepared oat feed, feed meal, corn chop, corn husks, corn silage, cowpeas, corn meal, and hay from Hungarian grass (*Setaria germanica*), herd's grass (*Agrostis vulgaris*), Bermuda grass (*Cynodon dactylon*), wild rye (*Elymus canadensis*), *Elymus striatus*, English rye grass (*Lolium perenne*), *Muhlenbergia mexicana*, *Panicum clandestinum*, switch grass (*Panicum virgatum*), English blue grass (*Poa compressa*), gama grass (*Tripsacum dactyloides*), wild millet, clover rowen, serradella (*Ornithopus sativus*), and heron's bill (*Erodium cicutarium*).

The composition of some of these feeding stuffs is given in the following table:

Composition of Southern feeding stuffs.

	Water.	Water-free substance.				
		Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Cotton-seed hull bran	7.96	3.99	1.80	54.12	37.34	2.75
Hay from—						
Wild rye	10.82	4.42	.96	54.09	36.64	3.89
English rye grass	11.15	13.58	8.00	44.06	26.57	7.79
Muhlenbergia mexicana	10.65	8.96	2.59	47.44	33.14	7.87
Panicum clandestinum	10.90	11.79	1.49	48.74	31.76	6.22
Switch grass	10.83	7.64	2.15	50.59	33.93	5.69
English blue grass, cut July 1, 1891	6.27	12.43	3.54	47.24	23.45	13.34
English blue grass, cut June 15, 1895	9.37	8.62	3.27	55.17	26.47	6.47
Gama grass	9.47	14.09	5.81	41.76	27.85	10.49
Wild millet	8.51	13.25	5.38	45.58	26.61	9.18
Heron's bill	12.94	13.63	5.99	46.55	23.37	10.46

The second part of the bulletin consists of a compilation of analyses of many Southern-grown feeding stuffs, and the composition of these is compared with the averages for the whole country. The coëfficients of digestibility of a number of American feeding stuffs, as obtained in experiments with ruminants and swine, are quoted, together with feeding standards.

Corn-and-cob meal vs. wheat for fattening steers, H. J. WATERS, W. C. PATTERSON, and E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 107–110*).—A feeding test was made with 20 high-grade Shorthorn steers about 31 months old, to compare corn-and-cob meal with chopped wheat. The test was divided into 3 periods. The first period began November 20 and lasted 30 days. All the steers were fed a mixed grain ration consisting of equal parts by weight of corn-and-cob meal and chopped wheat. In addition, corn stover and hay *ad libitum* were fed on alternating days. The nutritive ratio of the ration was 1:11.2. The period was preceded by a preliminary test of 3 weeks on the same ration. The second period began December 20 and lasted 34 days. The animals were divided into 2 uniform lots. Lot 1 was fed corn-and-cob meal and lot 2 chopped wheat, with the same coarse fodder as in the first period. The nutritive ratio of the ration fed lot 1 was 1:13.3, and lot 2, 1:10.1. The third period began January 23 and lasted 30 days. All the animals were fed the same ration as in the first period.

The weight of the food eaten by each lot during each period was determined, and on 1 day of each week the uneaten residues of corn stover and of hay were weighed. The moisture was determined in samples of the coarse fodder in each period, and corresponding corrections introduced in computing the composition of the material. The results are expressed in full in tabular form. The average results are given in the following table:

Results of experiments in feeding corn-and-cob meal and wheat to steers.

	Food consumed per head daily.				Total digestible matter consumed per head daily.	Average daily gain per head.	Digestible matter required per pound of gain.
	Corn-and-cob meal.	Chopped wheat.	Hay.	Corn stover.			
Period I:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
All steers (mixed grain)	5.77	5.77	12.68	5.62	12.05	1.43	8.41
Period II:							
Lot 1 (corn-and-cob meal)	11.08	....	8.86	5.92	12.89	1.67	7.73
Lot 2 (wheat chop)	....	9.90	9.98	6.72	12.77	1.47	8.67
Period III:							
Lot 1 (same as Period I)	6.40	6.40	9.24	5.28	12.96	1.15	1.22
Lot 2 (same as Period I)	6.23	6.23	9.06	6.06	12.85	1.17	10.91

The authors conclude that corn has a slightly higher value for fattening steers than wheat.

The relation of food to the growth and composition of the bodies of steers, W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 36–77*).—The object of this experiment was to determine the effect of wide and narrow rations upon the rate of growth and the composition of the bodies of 4 high-grade Shorthorn steers, 5 to 7 months old at the beginning of the test. Steers 1 and 2 were fed a ration rich in protein, having a nutritive ratio of 1:5.2, and containing linseed meal, corn meal, and wheat bran, in different proportions. Steers 3 and 4 were fed a

ration poor in protein, having a nutritive ratio of 1: 9.7, and containing 2 parts of corn meal to 1 part of bran. All the steers were fed hay, and during the winter corn fodder and silage also. Steers 1 and 3 were fed for 17 months, and steers 2 and 4 for 27 months. The results, including the analyses of the grain rations fed, are reported. The steer fed a ration rich in protein for 17 months consumed a total of 9,700 lbs. of food and made a gain of 737 lbs., while the steer fed the same ration for 27 months consumed 17,329 lbs. and made a gain of 962 lbs. The steer fed a ration poor in protein for 17 months consumed 10,234 lbs. and made a gain of 552 lbs., while the steer fed the same ration for 27 months consumed 16,041 lbs. and made a gain of 1,005 lbs. In discussing the experiment the author divides it into periods of about 90 days. The food consumed and the gains made by each steer for each period are expressed in tabular form.

At the end of about 17 months steers 1 and 3 were slaughtered, and the remaining steers (2 and 4) 10 months later. In every case the blood and the various organs of the carcass were weighed and analyzed. Tables are given which show the composition of the blood and organs, including the bones, spleen, and intestines. The percentage composition of the entire carcass, exclusive of skin and contents of stomach and intestines, and the composition of the right side and the edible portion of the entire carcass are also given in tabular form. The author discusses the effect of the different rations upon the composition of the carcass, and concludes that the two rations had no particular effect on the composition of the carcass and organs.

"(1) At the end of 15 months' feeding the pair of steers fed on the ration richer in protein had gained 221 lbs. of live weight more than the pair fed the ration less rich in protein. The later growth with 2 steers showed a difference in favor of the ration less rich in protein.

"(2) The relative weights of organs and parts of the body was practically the same with the steers of the same age, independently of the ration.

"(3) The kind of growth caused by the 2 rations, viz, the proportions of water, protein, fat, and ash, was not materially different with the steers of the same size. This is true whether we consider the entire bodies, the dressed carcasses, or the edible portions of the carcasses. With steers fed for the same time, the composition of the entire bodies, the proportion and composition of the carcasses, and the proportions and composition of the edible parts were practically alike.

"(4) The older pair of steers, viz, those fed for 10 months' longer time, contained a smaller proportion of water and a larger proportion of fat than the younger animals.

"(5) The older animals furnished 5 lbs. per 100 more of water-free edible material than the younger animals. This is equivalent to a difference of 12 lbs. of fresh edible meat."

Alfalfa or lucern, A. A. MILLS (*Utah Sta. Bul. 44, pp. 33*).—The work here reported is a continuation of that published in Bulletin 31 of the station (E. S. R., 6, p. 204). The object of these experiments was (1) to determine the yield and feeding value of early, medium, and late cutting, and first, second, and third crops of alfalfa, and to compare alfalfa as a feeding stuff with red clover and timothy; and (2) to compare alfalfa with mixed hay and with alfalfa mixed with straw.

Two tests are reported in which the first question was studied, the results being tabulated in detail. The first (1894–'95), lasting 102 days, was made with 9 lots of 2 steers each. Early, medium, and late cut alfalfa of the first and second crop, third crop alfalfa, timothy, and red clover were each fed to 1 lot. The test was divided into 2 periods. In the first period hay only was fed; in the second the steers were fed some bran and wheat. Analyses of the alfalfa and other feeding stuffs in this and succeeding tests are given.

The conclusion was reached that the best returns were given by red clover. Comparing the different crops and cuttings of alfalfa, "the late cutting of the first crop did the best, the medium next, and the early cutting the poorest. With the second crop the reverse was true, the late cut showing a loss."

The second test (1895–'96), which lasted 139 days, was made with 9 lots of 2 steers each, and was divided into 2 periods. First and second crop alfalfa, red clover, and timothy were fed as during the first test. The red clover and third crop alfalfa gave out about 6 weeks before the end of the test and the lots receiving them were fed mixed alfalfa for the rest of the test. During the whole test the steers were fed bran and wheat in addition to the hay.

"The early cut (alfalfa) did the best of the first crop, while the late cut did poorest. With the second crop the medium cut did the best and the late cut poorest. The red clover was below most of the others in rate of gain, while the timothy and third crop alfalfa made about an average showing."

The average results of these tests and those previously reported on feeding early, medium, and late cuttings are given in the following table:

Average results of feeding alfalfa to steers.

	Weight at beginning.	Weight at end.	Gain per day.	Food eaten per day.	Food eaten per pound of gain.
First and second crops:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Early cutting	893.86	1,009.44	1.08	20.88	19.34
Medium cutting	915.44	1,004.44	.83	20.72	24.96
Late cutting	923.67	1,019.72	.73	17.86	24.47
First crop (all cuttings)	907.70	1,017.09	.96	19.84	20.67
Second crop (all cuttings)	914.31	998.65	.80	19.94	24.93

The average results of feeding first, second, and third crop alfalfa, red clover, and timothy are given in the following table:

Average results of feeding alfalfa, red clover, and timothy to steers.

	Weight at beginning.	Weight at end.	Gain per day.	Food eaten per day.	Food eaten per pound of gain.
Alfalfa:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
First crop (all cuttings)	991.00	1,141.08	1.22	23.05	18.89
Second crop (all cuttings)	1,008.25	1,117.42	.92	22.35	24.29
Third crop	1,015.75	1,147.50	1.34	24.29	18.13
All crops and all cuttings	1,001.93	1,131.14	1.11	23.01	20.73
Red clover	1,009.75	1,118.25	.91	19.04	20.93
Timothy	1,018.25	1,162.50	1.19	21.97	18.46

The yield per acre of the different crops and cuttings of alfalfa are discussed at some length and the results expressed in tabular form.

"From the results of the 3 seasons' trials with alfalfa, early cut (just before bloom), medium cut (1 week after first bloom), and late cut (1 week after full bloom), the following conclusions seem warranted:

"(1) Steers, fed the alfalfa either with or without grain, made the most rapid gains on the early cut, and the lowest on the late cut, or they stand as follows: Early cut, 100; medium cut, 77; late cut, 68.

"(2) For both first and second crops the early cut was first in rate of gain, while for the first crop the late cut was better than the medium cut, and for the second crop the medium cut was far the better of the two.

"(3) The food eaten per day was slightly the highest for the early cut and lowest for the late cut, standing as 100 for the early cut, 99 for the medium cut, and 85 for the late cut.

"(4) Pound for pound, the early cut was the best, the late cut, second best, and the medium cut poorest. They stand as 100 for the early cut, 78 for the medium cut, and 81 for the late cut.

"(5) The early cut yielded the most hay when weighed into the barn, the medium cut coming second, and the late cut last.

"(6) The early cut contained the most moisture, and when all are reduced to the same moisture content, 12 per cent, which the hay contained when fed, the yield stands: Early cut, 100; medium cut, 93; and late cut, 90.

"(7) In amount of beef produced per acre the standing is: Early cut, 100; medium cut, 71; and late cut, 71.

"(8) In yield of protein, a very valuable nutrient, the standing is: Early cut, 100; medium cut; 78, and late cut, 82.

"(9) During the 2 weeks of budding and flowering there appears to be no additional growth; in fact, our results show a loss of 82 lbs. per acre of dry matter during this period"

Two tests were made in which the object was to compare alfalfa with mixed hay and with alfalfa mixed with straw.

The first test (1894–'95), lasting 123 days, was made with 3 lots of 4 steers each. Lot 1 was fed mixed hay, bran, and wheat; lot 2, alfalfa, bran, and wheat; and lot 3, alfalfa, straw, bran, and wheat. The animals were fed all they would eat.

The second test (1895–'96), which lasted 95 days, was made with 6 cows and 6 steers, divided into 3 uniform lots of 2 cows and 2 steers. The rations fed were the same as those used in the first test. The results of these trials are expressed in detail in tabular form.

The average results of the 2 tests are given in the following table, the financial statement being based on alfalfa at $3.50, mixed hay at $4.50, and straw at $1 per ton, and ground wheat at 65 cts., and bran at 45 cts. per 100 lbs.:

Average results for 2 years of feeding mixed hay, alfalfa, and alfalfa and straw to steers.

	Weight at beginning.	Weight at end.	Gain per day.	Cost of ration per month.
	Pounds.	*Pounds.*	*Pounds.*	
Mixed hay	930	1,228	2.27	$2.61
Alfalfa	921	1,164	1.86	2.30
Alfalfa and straw	924	1,233	2.34	2.21

The following conclusions were drawn:

"(1) In rate of gain per day the different feeds stand as follows: First crop alfalfa, 100; second crop alfalfa, 75; third crop alfalfa, 110. All crops alfalfa, 91; red clover, 75; timothy, 97.

"(2) The food eaten per day varies about in the same order as the gains, standing as follows: First crop, 100; second crop, 97; third crop, 105; all crops, 100; red clover, 80, and timothy, 95.

"(3) Pound per pound, the good alfalfa proved about equal to timothy, while in rate of gain it proved better.

"(4) A ration of alfalfa and straw, with grain, proved superior to one of alfalfa and grain.

"(5) Mixed hay and grain proved superior to alfalfa and grain, but not quite so good as alfalfa, straw, and grain.

"(6) A ration with a wide nutritive ratio, 1:8.6, proved much better than one with a narrow nutritive ratio, 1:4.56, while a ration having a nutritive ratio of 1:4.81 proved better than either of the others.

"(7) The use of mixed fodder in the rations, in one case mixed hay and in the other alfalfa and st aw, appeared to have much more to do with the feeding value than did the nutritive ratio of the rations. However, the ration that was nearest the Wolff standard gave the best results.

"(8) Better results were obtained by making the ration wider than the standard by 2.6 than making it narrower by 1.44.

"(9) By feeding what straw the animals will eat up clean; our foods rich in protein, alfalfa, bran, and wheat may be fed to good advantage, though the nutritive ratio be too narrow.

"(10) Where the rations contained but one class of fodders, legumes, the feeding value very closely followed the amount of protein in the ration; but when the rations contained any other fodders, mixed hay, timothy, or straw, the varying amounts of protein in the ration appeared to have little to do with the variation in feeding value of the ration."

Stock feeding experiments at Lander, B. C. BUFFUM (*Wyoming Stat. Bul. 30, pp. 255–264*).—Feeding experiments were made to compare the relative value of sugar beets and grain for steers and sheep.

Experiment with steers (pp. 257–261).—A test, divided into 3 periods, was made with 6 steers in fair condition. They were from the open range, but had been put in the fields and winter fed. Nos. 1 and 2 were grade Shorthorns, 3 and 4 grade Polled Angus, and 5 and 6 ordinary range steers. The animals were about 3 years old and had been dehorned. The first period, which was regarded as preliminary, began January 19 and lasted 41 days. The steers were all fed alfalfa hay, consuming 5,529 lbs., or an average of 22.48 lbs. per head daily. The second or intermediate period began March 1 and lasted 11 days. The steers were divided into 2 lots of 3 each. Lot 1 (steers 1, 3, and 6) were fed alfalfa hay and sugar beets, and lot 2 (steers 2, 4, and 5) were fed alfalfa hay, chopped oats, and cracked wheat. The amount of beets and grain was gradually increased until at the close of the period 14 lbs. of beets, 7 lbs. of chopped oats, and 9 lbs. of cracked wheat were fed per head daily. The third period, or feeding test proper, began March 12 and lasted 40 days. The rations were the same as those fed in the second period. The steers consumed 6,505.5 lbs. of hay, or an average of 26.03 lbs. per head daily. The gains in weight for each steer for each

period are given in tabular form. The average gain of the 6 steers for the whole test was 117.5 lbs., or 1.28 lbs. per day. The average gain of the steers fed alfalfa and sugar beets was 117 lbs., or 1.27 lbs. per day; of those fed alfalfa and grain 118.2 lbs., or 1.28 lbs. per day. The Shorthorns gained 85 lbs., the Polled Anguses 149.7 lbs., and the range steers 118 lbs. each.

The financial statement is based on alfalfa hay at $4 and sugar beets $3.50 per ton, and wheat and oats $1 per 100 lbs. The Shorthorn steers cost $30, Polled Angus $25, and range $25 each, and they were sold for $3.35 per 100 lbs. live weight. The author calculates the profits from each lot and each breed.

"The lot fed on alfalfa and sugar beets returned a net profit, above a fair price for feed given, of $3.45 apiece, and the lot fed on alfalfa and grain a loss of $2.38 apiece.

"Net profit on the 6 steers was $0.59 each. This would be sufficient to pay for feeding where large numbers were handled."

Experiment with sheep (pp. 261-264).—A test was made with 3 ewes 4 or 5 years old and 3 lambs, purchased from the open range. The sheep were, in the author's opinion, fat enough for slaughtering at the beginning of the test. During the first period, which began December 1 and lasted 63 days, the ewes were separated from the lambs, and each lot was fed alfalfa hay. During the second period, which began February 2 and lasted 30 days, the sheep were divided into 3 lots, each lot consisting of 1 lamb and 1 ewe. Lot 1 was fed hay alone, lot 2 hay and sugar beets, and lot 3 hay and cracked wheat. The third period began March 3 and lasted 28 days. During this period the sheep were put together, and fed hay, sugar beets, and wheat to finish them for the market.

The food consumed and the gains in weight for each sheep for each period are tabulated. The total food consumed was 2,409.5 lbs. and the total gain 93 lbs., or 25.9 lbs. of food per pound of gain. The financial statement is based on hay at $4 and sugar beets at $3.50 per ton, and grain at $1 per 100 lbs. The sheep cost $3 apiece at the station and at the close of the test were sold at 6 cts. per pound and slaughtered. The dressed weights ranged from 35 to 60 lbs. The ewes produced 49.3 per cent of mutton as compared with live weight and the lambs 45.7 per cent. The ewes returned a profit of 52 to 81 cts. each, and with the lambs there was a loss of from 9 to 31 cts. each.

"The lot fed hay and sugar beets during the second period gave better returns than those fed hay alone or those fed hay and grain.

"The ewes gave better gains and greater profit than did the lambs.

"The average results of the 6 sheep show a fair return for the feed given, with enough profit to meet all expense of feeding where larger numbers are handled.

"The rations fed were not properly balanced and give a ratio which is too wide. The best balanced ration gave the best returns in each case."

Pork production on crops gathered by hogs. A succession of crops for hogs, R. L. BENNETT (*Arkansas Sta. Bul. 41, pp. 45-57*).—An experiment was made "to determine the adaptability of different

crops in a rotation for hogs; the cost of rearing 10-month pigs on foods gathered by themselves and grown on soil of known fertility; and to ascertain a system of rearing pigs for pork with a minimum quantity of corn."

The test was made with 5 pigs, crossbred from a grade Poland-China sow and a Berkshire boar. The pigs were barrowed March 3 and were kept with the sow until May 13. Until July 29 corn meal and wheat bran were fed in addition to the forage crops. From March 23 to March 30 the sow and pigs were pastured on rye, from March 30 to July 26 on clover, and from July 26 to September 21 on sorghum. From September 21 to October 3, 2 of the pigs were pastured on sweet potatoes and the others on peanuts. The sweet potatoes were not relished, and from October 3 to December 2 all were pastured on peanuts. On December 2 the ground froze and the pigs could not get at the peanuts. They were therefore fed on corn until January 3, when they were slaughtered. The corn was shelled and soaked in water, and the pigs were fed all they would eat.

The forage crops were grown on 1.1 acres of "a worn, sandy loam, deficient in vegetable matter, which would produce about 25 bu. of corn to the acre in a good season." The details of raising the crops and the results of the experiment are tabulated.

The combined weight of the pigs September 21 was 565 lbs. From this date to December 2 the total gain in weight was 471 lbs., or an average of 1.31 lbs. daily. January 3 (date of slaughtering) the combined weight of the pigs was 1,215 lbs. and the average weight 243 lbs. During the last 31 days the pigs consumed 19 bu. of corn and made a total gain of 179 lbs., or an average of 1.15 lbs. per day and 9.4 lbs. per bushel of corn.

The financial statement is based on wheat bran at 65 cts. per 100 lbs. and corn meal and corn at 30 cts. per bushel. Taking into account the total value of the grain, the cost of growing the green crops, and the rent of the land, the total cost of raising the pigs was $18.11. They were sold at the rate $3.25 per 100 lbs., for $39.48, yielding a profit of $21.37, or an average of $4.25 per pig. The average cost of making 1 lb. of pork was 1.5 cts.

From this experiment the author draws the following conclusions:

"Red clover, sorghum, and peanuts were the foods best adapted for rotation. They are cheap and easy to produce, and their seasons of maturity are in convenient order for pigs to consume them. . . . Sweet potatoes were unequal to the peanuts in palatability and as fat and flesh formers. . . .

"The rotation of red clover, sorghum, and peanuts required $6\frac{3}{5}$ bushels of corn to produce a hog weighing 243 lbs. at 10 months old. Less corn could have been fed in farm practice by keeping the pigs 2 weeks longer on peanuts in December, and feeding corn only while the ground was frozen. Two weeks' feeding on corn would have been sufficient to harden the pigs for slaughter."

Experiments in feeding draft horses, L. GRANDEAU, H. BALLACEY, and A. ALEKAN (*Ann. Sci. Agron., 1896, II, No. 1–2, pp. 113–237*).—This is the seventh and concluding series of experiments on the

feeding of draft horses made by Grandeau and his associates for the *Compagnie Générale de Voitures* of Paris, to compare the mixed ration fed by the *Compagnie Générale* and the several ingredients composing it. The results of the earlier experiments have been previously noted (E. S. R., 6, p. 1018). In the present series the ration consisted of so-called "maize cake" and oat straw. The cake was prepared from starch factory and distillery waste and contained some potato and barley as well as maize refuse. It had been fed for a number of years and was found to be very constant in composition.

The experiments were made with 3 horses, 10, 12, and 9 years old, weighing 478.3, 505.3, and 491.4 kg., respectively; and cover a period of 13 months divided into periods of about a month duration. Horse No. 2 met with an accident and was dropped out 5 months before the conclusion of the trial. The experiment proper was preceded by a preliminary test of 5 months, during which the transition was made from the preceding ration to the one used in the experiment.

The experiment includes periods of rest, walking, trotting, working and walking, working and trotting, the work consisting in turning the arm of a dynamometer of special construction a definite number of times. Experiments were also made at moderate and severe work drawing a cab. The amount fed was modified to suit each condition. Tables are given showing the amount and composition of food consumed, amount of water drunk, coëfficients of digestibility, amount and composition of the feces, and in a number of cases of the urine produced, and variations in temperature and weight of each horse for each day of each period.

The average coëfficients of digestibility of the rations under various conditions of rest and work are given in the following table:

Average coëfficients of digestibility of "maize cake" and straw by horses.

	Dry matter.	Organic matter.	Protein.	Fat.	Crude cellulose.	Sugar yielding cellulose.	Starch.	Sugar.	Undetermined.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
At rest	51.79	54.09	66.34	32.32	36.99	41.65	90.87	100.00	37.82
Walking	49.76	52.44	63.69	39.67	33.79	35.88	90.93	100.00	32.02
Trotting	54.83	57.11	71.08	47.31	40.07	46.99	88.54	100.00	40.35
At work walking	51.74	54.03	67.47	45.59	31.35	32.80	90.09	100.00	35.15
At work trotting	51.46	53.85	69.59	50.51	28.02	33.45	88.30	100.00	31.35
Drawing a cab	54.73	57.23	68.44	28.85	32.73	38.20	94.57	100.00	36.75

In a number of cases the nitrogen balance was also determined, taking into account the nitrogen in the food, urine, feces, sweat, and material removed in currying, as well as the nitrogen lost from the feces while drying and in the material worn away from the hoofs.

In the authors' discussion of the experiments the ration of maize cake and straw is compared at length with the rations fed in previous tests on the basis of its composition and fuel value and also upon the basis of gain and loss in weight.

The following are some of the principal conclusions reached by the authors: A horse of 500 kg. weight by the motion of forward progression through a horizontal distance of 10 kilometers at a speed of 1.5 meters per second loses 2.4 kg. in weight. A horse of the same weight covering a distance of 10 kilometers with a velocity of 1.5 meters per second and producing 190,000 kilogrameters of work loses about 3.8 kg. in weight.

Generally speaking, horses digest from a ration of maize cake (1) sometimes more and sometimes less carbohydrates, but always 2 or 3 times as much protein as from a ration of hay; (2) less carbohydrates, but more protein than from a ration of oats and maize, and (3) less carbohydrates and protein than from a ration of horse beans.

In general when no work is performed horses gain in weight when oats are consumed, but the gain is not proportional to the quantity eaten. The gain is less with hay, which also furnishes less available energy. On the other hand, maize cake does not produce a gain comparable with that from maize and beans. When walking the gains in weight of horses vary with the different rations, being greatest on maize, followed by beans, maize cake, oats, and hay, in the order mentioned. The superiority of maize cake to oats is still more noticeable when it is remembered that the quantities assimilated from the former are much less than from the latter. On this basis the apparent superiority of the maize and especially of the beans diminishes. As a ration for horses when trotting hay is much inferior to the other feeding stuffs used as regards gains in weight, and it can also be said that the nutritive elements assimilated from this feed are much inferior in quality. Maize cake produced less satisfactory results than beans, and maize than oats as regards the available energy furnished. For work done in drawing a cab maize at first seemed to be inferior to the other rations, but this was not the case. The quantity fed did not furnish a sufficient amount of nutriment, which was also true of the oats, cake, and beans. It appeared that the cake was much superior both to hay, a coarse fodder, and to beans, which may be regarded as a type of feeding stuffs rich in protein. On the other hand, the cake is much inferior to feeding stuffs like corn and oats, which are rich in starch and moderately rich in protein. Its coëfficient of digestibility is midway between corn and oats, as is also its nutritive ratio.

From a practical standpoint maize cake, which is a commercial by-product, satisfies all the demands of the organism of the horse. Its chemical analysis indicates this and experience has proven it. Horses consuming a ration of cake and straw for a year remained in good health. It would be advantageous to feed more cake than was fed in these experiments.

Feeding experiments with laying hens: The relative efficiency of whole and ground grains, W. P. WHEELER (*New York State Sta. Bul. 106, n. ser., pp. 153–162*).—A feeding experiment was made with 4

lots of laying hens to test the relative value of ground and whole grains. Lots 1 and 2 were White Leghorns and lots 3 and 4 Buff Cochins. Each lot contained about the same number of hens. The experiment began December 14 and continued 1 year, being divided into periods of 28 days each. The detailed results for each period are not given. The hens were kept in pens about 10 by 12 ft., and each lot had access to a small yard deeply covered with coal ashes. Previous to the experiment the hens were fed a ration similar to that used during the test.

Lots 1 and 3 were fed in the morning a mixture of ground grain which was moistened with hot water and fed warm during cold weather, and moistened with water at ordinary temperature during hot weather. They were fed all they would eat readily of this mixture, and during the day they were given a little whole grain scattered in straw in addition. The grain mixture consisted of ground flaxseed, wheat bran, wheat middlings, corn meal, ground oats, ground barley, and ground buckwheat. During several months the flaxseed was omitted.

Lots 2 and 4 were fed practically the same mixture of grain whole, with cracked corn. It was scattered on the floor of the pens and none was left uneaten.

Twice a week the 4 lots were fed all the cut fresh bones they would eat and during 3 periods skim milk was also fed. Either green alfalfa, cabbage, corn silage, or soaked chopped hay was fed at noon, the moistened hay being fed warm to lots 1 and 3. The hens always had access to stone grit and oyster shells.

The average composition of the grain mixture and the other foods, as well as the results of the experiment, are given in tabular form. The financial statement is based on corn at 50.1 cts., oats at 37.9 cts., barley at 61.4 cts., and buckwheat at 56.1 cts. per bushel; wheat bran at $16, wheat middlings at $17, corn at $19.20, ground oats at $24, ground barley at $25.60, ground buckwheat at $23.60, alfalfa hay at $9.60, alfalfa forage at $2, and cabbage and corn silage at $3 per ton; skim milk at 24 cts., cut bone at 80 cts., oyster shells at $1, and stone grit at $1 per 100 lbs.; and flaxseed, ground or whole, 2½ cts. per pound.

The results are briefly summarized in the following table:

Results of experiments in feeding hens whole and ground grains.

	Average number of eggs per hen.	Average weight of eggs.	Water-free food consumed per pound of eggs.	Cost of food per pound of eggs.
		Ounces.	*Pounds.*	*Cents.*
Lot 1 (ground grain)	92.94	194.15	5.30	6.95
Lot 2 (whole grain)	77.03	165.81	6.47	8.44
Lot 3 (ground grain)	47.51	95.39	13.01	17.15
Lot 4 (whole grain)	63.72	126.85	10.04	13.00

"(1) Two pens of laying hens, one of a large and the other of a small breed, having a ration the grain of which was whole, ate during their second year somewhat more food at a little greater cost than 2 similar pens having a ration in which half the grain was ground and moistened.

"(2) Cochin hens, having the whole grain ration laid much better than those having the ground grain, although neither lot laid at a profitable rate during the second year.

"(3) Leghorn hens having a ration in which the grain was whole consumed on the average for 2 years over 20 per cent more food for the same egg production than did similar hens having half the grain in their ration ground and moistened."

Researches on the physiology of muscular action, A. CHAUVEAU and J. TISSOT (*Compt. Rend., 124 (1897), No. 1, pp. 16–21*).—The authors report briefly the results of 2 series of experiments in which the respiratory quotient was determined under various conditions of work.

Experiments upon metabolism in the human body under the direction of the United States Department of Agriculture (*Science, 5 (1897), No. 117, pp. 493–496*).—The article gives a very brief description of a respiration calorimeter and experiments made with it, which have been carried on at Wesleyan University in coöperation with the Storrs Experiment Station and this Department.

New work in physiology as related to metabolism, O. HAGEMANN (*Milch Ztg., 26 (1897), No. 1, pp. 4–6*).—A brief digest of some of the recent work which treats of metabolism from the standpoint of energy.

The length of time which milk remains in the stomach under various conditions, R. W. RAUDNITZ (*Milch Ztg., 26 (1897), No. 6, p. 87*).—A brief report of experiments with cats.

The digestion by the stomach of Gärtner's prepared milk, E. SCHÜTZ (*Wiener klin. Wochenschr., 1896, No. 48.*

Gärtner's prepared milk, NIEDERSTADT (*Milch Ztg., 26 (1897), No. 6, p. 88*).—Analyses of this prepared milk from a factory.

A discussion of certain commercial articles: Foods, W. H. JORDAN (*Maine Sta. Rpt. 1895, pp. 135–138*).—A reprint of Bulletin 20 of the station (E. S. R., 7, p. 884).

Some additions to our vegetable dietary, F. V. COVILLE (*U. S. Dept. Agr. Yearbook 1895, pp. 205–214, figs. 9*).—The author describes in detail a number of plants which might be profitably used as pot herbs, including charlock, Swiss chard, chicory, winter cress, dock, kale, marsh marigold, mercury, black mustard, orach, pigweed, pokeweed, purslane, winter purslane, spinach, and New Zealand spinach. The author believes that a more extended use of these vegetables would prove of benefit.

"The plants enumerated here do not by any means comprise all the species that might be used as pot herbs, but they have been selected so as to suggest to people in every part of our country certain plants growing in their own region which are available for use in this manner. Doubtless others, particularly among our native plants, such as the common nettle, milkweed, and the round-leafed mallow, commonly known to children as 'cheeses,' will be found equally important."

The mineral matter in the feed of our domestic animals (*Landw. Centbl. Posen, 25 (1897), No. 5, p. 27*).—A general article.

Lime and phosphoric acid in the development of animals, L. FONTAINE (*Ind. Lait., 21 (1896), No. 48, pp. 379, 380*).

Oil cakes as food and as a fertilizer, A. LARBALÉTRIER (*Les tourteaux de grames oleagineuses comme aliments et engrais. Paris: G. Masson, 1896, pp. 202; rev. in Bot. Centbl., 69 (1897), No. 2–3, pp. 86–88*).

Maize germ cake, J. F. VAN PESCH (*Landw. Vers. Stat., 47 (1896), No. 6, pp. 473–475*).—Analyses are given.

Silk-cotton-tree seed cake, J. F. VAN PESCH (*Landw. Vers. Stat., 47 (1896), No. 6, pp. 471–473*).—The author gives an analysis of cake made from the seed of the silk cotton-tree (*Eriodendron anfractuosum*)), and describes a method for detecting adulteration in this cake.

The feeding value of beet-leaf silage, LEHMANN (*Ztschr. landw. Ver. Rheinpreussen, 13 (1896), No. 47, pp. 393–395*).—Three experiments with sheep are briefly reported. The conclusion was reached that beet-leaf silage, even after it had been washed, possessed about the same nutritive value as mangel-wurzels.

On molasses feeding stuffs, A. EMMERLING (*Landw. Wochenbl. Schles. Holst., 47 (1897), Nos. 8, pp. 129–131; 9, pp. 145–148*).—A general article.

The dry matter content of a desirable mixed ration, J. KÜHN (*Deut. landw. Presse, 23 (1896), No. 101, pp. 895, 896*).—A general article.

Feeding experiments with prickly pear (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 658, 659*).—Prickly pear was cooked with meat refuse or with a little molasses and fed for a long period to pigs with favorable results.

The substitution of barley for oats as food for horses, H. HAMBRO (*Deut. landw. Presse, 23 (1896), No. 100, p. 891*).—A general discussion showing that barley may be substituted for oats in feeding horses, with a brief report of a test with horses made by the Birmingham corporation in which barley and oats were compared.

Rational stock feeding, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1895, pp. 16–23*).—Reprinted from the Annual Report of the station for 1894 (E. S. R., 7, p. 985).

Comparative experiments in feeding cattle, G. CORMOULS-HOULÈS (*Prog. Agr. et Vit., 25 (1896), No. 25, pp. 693–695*).—A brief report is given of feeding experiments with 5 lots of 4 steers weighing about 1,600 kg. each, to test the comparative value of wheat, rye, potatoes, and cotton-seed cake. Among the conclusions reached were the following: Cotton-seed cake is more economical than grains, especially wheat. It is more advantageous to feed potatoes than to sell them to the distilleries.

Rouen ducks, LEROY (*Jour. Agr. Prat., 61 (1897), I, No. 7, pp. 241–246*).—A general article.

DAIRY FARMING—DAIRYING.

Influence of the quantity of food upon the economy of milk and butter production, H. J. WATERS and E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 24–55*).—An experiment was made with 9 cows, mostly Jerseys and grade Guernseys, lasting 150 days and divided into 5 periods of 30 days each. In all the periods the food consisted of mixed hay and corn stover *ad libitum*, with varying amounts of a grain mixture consisting of 7 parts of corn meal and 3 of cotton-seed meal. On the first 10 days in each period a digestion experiment was made with 3 cows selected as representing the lot. From the results the amounts of digestible ingredients consumed were calculated for each cow in each period. These data, together with the yield and fat content of the milk and the calculated yield of butter, and the financial results are fully tabulated and discussed. The financial results are based on corn meal at \$20, cotton-seed meal at \$26, mixed hay at \$12, and corn stover at \$4 per ton; butter at 30 cts. per pound, and solids-not-fat of the milk at 2 cts. per pound. The financial results are shown graphically. A summary showing the amount of the grain mixture fed in each period and the results is given below:

Effect of feeding different amounts of grain to milch cows.

Period.	Amount of grain mixture.	Digestible nutrients eaten per day.				Average daily yield.			Digestible food eaten per—		Average net profit per day.
		Total.[1]	Protein.	Carbohydrates.	Fat.	Milk.	Fat content of milk.	Butter.[2]	100 lbs. of milk.	Pound of butter.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent*	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
1	6	14.01	1.47	10.96	0.50	16.90	4.60	0.898	90.68	15.60	14.87
2	12	15.98	2.09	12.11	.66	17.29	4.85	.973	102.66	16.77	13.92
3	18	17.19	2.59	12.29	.81	17.68	4.96	1.003	106.12	17.19	12.05
4	12	14.25	2.23	10.01	.72	16.30	5.11	.976	95.46	14.81	14.04
5	6	10.64	1.51	7.99	.45	12.73	5.55	.827	89.51	12.86	15.10

[1] Fat reduced to starch equivalent by factor 2.25.

[2] Calculated by adding one-fifth to total butter fat.

"A comparison of the different rations fed clearly shows that less digestible matter was required to produce 100 lbs. of milk and a pound of butter in the periods of light feeding than when larger quantities were fed. . . .

"Charging the animals with the food consumed and crediting them with the butter and solids-not-fat produced . . . shows that as the cost of the ration increases, due to the increased amount consumed and the larger proportion of grain fed, the daily net profit returned diminishes, although not in the same ratio. . . .

"It appears that two factors were operating to cause a decrease in the daily net profit returned as the amount of food consumed was increased, viz, a decreased relative consumption of the cheaper coarse fodders, necessitating a large increase both relative and absolute in grain consumed, and an increase in the food eaten above the point at which the animals used in the experiment were able to produce the greatest amount of milk and butter per pound of digestible matter consumed in the food.

"It might have been expected that the increase in the relative amount of grain in the ration would serve to increase the efficiency of a unit of digestible material, but it does not appear from the results that there was any material increase of this sort. . . .

"A striking lesson taught by the results of the experiment is the difference between individual cows with respect to their ability to produce milk and butter cheaply. The difference between the profits returned by the best and poorest cows for the 150 days of the experiment was $33.10, as shown in the following statement:

Profits from feeding the best and the poorest cows.

	Cost of food.	Value of products.	Net profit.
Best cow	$26.67	$64.32	$37.65
Poorest cow	23.51	28.06	4.55
Difference	3.16	36.26	33.10

"Other differences less striking are shown between other cows of the lot.

"It was not found possible to trace any connection between these differences and the type or conformation of the animal. Thus, 2 animals conforming equally to the generally accepted dairy type exhibit a difference in the net profit returned during the 150 days of the experiment of $14.99. Between 2 others not sensibly different in conformation a difference of $12.48 is noted."

The feeding of cotton-seed meal, up to 4.44 lbs. per day for 30 days, was not attended by any apparent ill effect on the health of the animals, either at the time or afterwards.

Influence of nutritive ratio upon the economy of milk and butter production, H. J. WATERS and E. H. HESS (*Pennsylvania Sta. Rpt. 1895, pp. 56–74*).—Nine Guernsey and grade Guernsey cows, about 60 days from calving, were fed for 4 periods of 30 days each to test this point, and incidentally to compare old-process linseed meal and cotton-seed meal. Throughout the experiment from 6 to 7 lbs. of chopped wheat was fed, together with corn stover *ad libitum*. In the first and fourth periods 5 lbs. of Buffalo gluten meal was fed, which in the second perio was replaced by 5.26 lbs. of cotton-seed meal, and in the third period by 5.99 lbs. of old-process linseed meal. The cows did not consume as much corn stover as was expected, so that the nutritive ratio in all the periods was narrower than contemplated.

Full data for the food and nutrients consumed, the yield and composition of the milk, and the financial results are tabulated, and the influence of the nutritive ratio upon the composition of the milk is shown graphically. The financial results are based on ground wheat at $20, Buffalo gluten meal at $18, cotton-seed meal at $20, linseed meal at $25, and corn stover at $4 per ton; butter at 28 cts. per pound, and solids-not-fat of the milk at 2 cts. per pound. A summary of the data is given below.

Effect of rations of different nutritive ratio on milch cows.

Period.		Digestible nutrients eaten per day.				Total yield of—		Digestible food consumed—		Average net profit per day.
		Protein.	Carbohydrates.	Fat.	Nutritive ratio.	Milk.	Butter.[1]	Per 100 pounds of milk.	Per pound of butter.	
		Pounds.	*Pounds.*	*Lb.*		*Pounds.*	*Pounds*	*Pounds.*	*Pounds.*	*Cents.*
1	Buffalo gluten meal	1.52	8.80	0.56	1:6.6	4,418.75	224.07	76.26	14.98	14.10
2	Cotton-seed meal	2.62	8.33	.85	1:3.9	4,381.90	253.99	87.73	14.95	15.58
3	Linseed meal	2.38	9.05	.59	1:4.4	4,087.70	258.32	91.22	14.37	14.24
4	Buffalo gluten meal	1.52	8.85	.57	1:6.7	3,701.70	221.88	94.39	15.60	13.24

[1] Calculated from total fat by adding one-fifth.

"Seven of the 9 cows used in the trial required less digestible material for a pound of butter in periods 2 and 3, when the nutritive ratios were 1:3.9 and 1:4.4, respectively, than was required in periods 1 and 4, when the nutritive ratios were 1:6.6 and 1:6.7.

"The average of all cows in the trial shows a requirement of 15.29 lbs. of digestible matter per pound of butter produced, when the nutritive ratio averaged 1:6.65, and 14.66 lbs. when the nutritive ratio was reduced to 1:4.15, an apparent increase of 4 3 per cent in the efficiency of the food in the periods of narrower nutritive ratios. . . .

"It appears that in those periods where the narrower nutritive ratios were fed a slightly higher profit on the foods was shown. This was true notwithstanding the fact that somewhat more total food was consumed in the periods with the narrower ratio than in those with the wider ratio. The tendency of this would probably be as illustrated in the experiment of 1893–'94 upon the influence of the quantity of food upon the economy of milk and butter production, viz, to decrease the relative profit on the food. The narrowing of the nutritive ratio, however, not only counteracted this tendency, but resulted, as shown, in an increased profit."

As to the effect on the composition of milk of feeding rations of different nutritive ratio, the following table summarizes the results:

Average composition of milk on rations of different nutritive ratio.

	Nutritive ratio of food.	Total solids.	Fat.	Fat in total solids.	Nitrogen.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Period 1	1:6.60	13.11	4.09	31.01	0.560
Period 2	1:3.90	14.01	4.74	33.63	.593
Period 3	1:4.40	14.49	5.13	35.26	.617
Period 4	1:6.70	14.02	4.87	34.56	.602
Average of 1 and 4	1:6.65	13.56	4.48	32.79	.580
Average of 2 and 3	1:4.15	14.25	4.98	34.45	.605

"From the table it appears that the narrower nutritive ratios tended to increase the percentage of fat, of total solids, and of nitrogen, and the proportion of the total solids that are fat. . . .

"Plainly, the fat content of the milk increased more rapidly when narrow nutritive ratios were fed than did the other solids. . . . [As to the relative values of cotton-seed meal and old-process linseed meal] apparently cotton-seed meal at $20 per ton is more profitable than linseed meal at $25.00. If, however, we rate the cotton-seed meal at $25 per ton—the price put on the linseed meal—a daily net profit of 14.29 cts. is returned, compared with 14.24 cts. from the linseed-meal ration, or practically the same amount."

Effects of drought upon milk production, L. L. VAN SLYKE (*New York State Sta. Bul. 105, n. ser., pp. 131–152*).—This bulletin gives a summary of the results of analyses of the milk of 50 herds of cows which was taken to a cheese factory in the State during the season of 1895 (May to October). The object was to study the variations which milk undergoes as the result of climatic conditions, notably of a severe drought occurring early in the summer. A summary of the results by months is given in the following table:

Variation of fat, casein, cheese, etc.

Month.	Fat in 100 lbs. of milk.	Casein in 100 lbs. of milk.	Casein for 1 lb. of fat in milk.	Cheese made from 100 lbs. of milk.	Cheese made for 1 lb. of fat in milk.
	Pounds.	*Pounds.*	*Pound.*	*Pounds.*	*Pounds.*
May	3.58	2.40	0.67	9.94	2.78
June	3.59	2.33	.65	9.77	2.72
July	3.71	2.20	.59	9.58	2.58
August	4.04	2.26	.56	10.10	2.50
September	3.97	2.47	.62	10.54	2.65
October	4.20	2.69	.64	11.35	2.70

The percentage of fat was about the same in June as in May, and after that increased during the season. The casein, on the contrary, was less in June than in May and still less in July. In June and July less cheese was made from 100 lbs. of milk than in preceding months.

"The decreased yield and cheese-producing power of the milk in July and August were mainly due to insufficient nutrition caused by the drying up of the pastures. Had the cows been properly supplied with abundance of nutritious, succulent food, it is estimated that the yield of milk and cheese would have been increased to the extent of $5 a cow on an average.

"In this State drought generally prevails at some time during the summer. Provision should be made to supplement dried pastures. For this purpose corn silage, alfalfa, and oat and pea fodder are recommended."

Brief directions are given for the culture of these green fodders.

Feeding experiments with milch cows, J. M. BARTLETT (*Maine Sta. Rpt. 1895, pp. 24–35*).—*Wheat meal compared with corn meal* (pp. 24–30).—A comparison was made on 6 cows in 3 periods of 21 days each of feeding rations of 18 lbs. of timothy hay, 2 lbs. of cotton-seed meal, and either 5 lbs. of wheat meal or 5 lbs. of corn meal. The wheat meal was fed in the first and third periods and the corn meal in the second period. The data relative to the experiment, including the

composition of the feeding stuffs used and of the milk produced, are tabulated.

The following conclusions are drawn:

"(1) Wheat meal pound for pound furnishes more food than corn meal, noticeably more digestible protein.

"(2) When wheat can be bought at about the same price as corn it is a more economical grain to buy.

"(3) It is more valuable than corn to feed with hay or such grains as barley and oats because richer in protein.

"(4) When fed to milch cows in the proportions given in this experiment, it produced as much milk and greater gain in flesh. It is very noticeable that the [wheat-meal] rations fed in periods 1 and 3 were more efficient than [the corn meal] fed in period 2. While there was a very gradual and uniform shrinkage in milk solids through all the periods, due to the advance in time of lactation, the fact that the cows all lost weight in period 2 and gained again, with the exception of No. 4, in period 3, furnishes good grounds for the above statement."

Silage composed of mature flint corn, sunflower heads, and peas as food for milch cows (pp. 30–35).—The silage was the Robertson mixture, except that black-eyed peas were substituted for the horse beans. This was tested with 5 cows in 5 periods of 14 days each, feeding it in connection with hay and as a partial or total substitute for a grain ration of corn meal, cotton-seed meal, and bran. From 30 to 50 lbs. of silage was fed per head daily. The data, including the composition of the feeding stuffs and of the milk, are tabulated. From these data the results are summarized as follows:

"(1) The materials composing the silage used can be perfectly preserved and successfully kept in the silo as late as June of the following year.

"(2) The pea, sunflower, and corn mixture produces a silage somewhat richer in protein than corn alone and is very greedily eaten by stock.

"(3) To attempt to substitute this mixture entirely for the grain ration was not a success, the cows shrinking quite materially in their flow of milk without an increase in its richness. The shrinkage was undoubtedly due to a lack of digestible protein; the total and digestible organic matter consumed was practically the same but the protein was considerably less than in period 1. On returning to the grain and silage ration in period 3 the flow of milk was increased to nearly the original yield.

"(4) In period 4 silage was substituted for one-half the grain ration, 20 lbs. silage for 3 lbs. grain, with good results. All the cows increased in weight and shrank no more in milk than would be expected from the advance in time of lactation, the solids and fat increasing slightly."

On the variation in the number and size of fat globules in milk, M. E. McDonnell and J. W. Fields *Pennsylvania Sta. Rpt. 1895, pp. 75–85*).—The observations here reported were made in connection with the experiments on the effect of quantity of food and of nutritive ratio upon milk production, reported above (p. 823). In the experiment on the effect of nutritive ratio the observations were confined to one cow, and the results are given for periods of 6 days throughout the trial and are shown graphically. Comparisons were made of the size of the globules when the cow was on different rations, temporarily ill, and under other varying conditions.

"These comparisons showed the relative size of the globules to vary more uniformly with the total yield of milk than with any other factor. In nearly all cases where the cow was in a normal condition, a decrease of milk production was accompanied with a diminution in the average size of the globules, and this size increased when from any cause a large yield of milk was produced. Apparent slight variations from this rule may be due to errors in some part of the work."

In the other experiment the number and relative size of the globules in the milk from all of the cows was determined on the 14th to 16th and the 26th to 28th days of each of the 5 periods. The results of these observations are also tabulated and shown graphically.

"It is evident that the size of the fat globules varies in a direct ratio with the milk yield.

"The influence of the quality and quantity of food upon the size of the globules appears to be indirect, the real cause of variation being the variation in the milk production. The size of the globules bears nearly the same relation to the actual amount of butter fat produced, but the relation of the actual yield of fat to the milk production is so close that any variation in the fat globules conforming to one would necessarily bear almost the same relation to the other.

"This hypothesis is very well supported by our observations, especially when we consider the number of observations taken, and at the same time is not at variance with but is in reality an explanation of the observations of Woll and others. If it be true, the method of feeding so as to produce the largest globules resolves itself into this: Feed so as to produce the largest possible yield of milk while keeping the cow in a normal condition."

The relative composition of milk, cream, and skim milk, N. LEONARD and H. M. SMITH (*Analyst, 21 (1896), Nov., pp. 283–285*).—The data are given for several experiments in which milk of known composition was set for 18 hours, and different proportions of the upper and lower portions mixed and analyzed. The solids-not-fat and the ash in these are calculated on the water basis, *i. e.*, "dividing the percentage of solids-not-fat and of ash, respectively, by the percentage of water in the various samples, and multiplying the quotients by 100." The indications were that there is no change in the relation between water and solids-not-fat in the raising of cream, but that the relation remains the same in the cream and the skim milk as it was in the whole milk. "We would further suggest that in estimating the amount of added water (if any) present in samples of milk containing an abnormally high or low proportion of fat, it is desirable to take as a basis for the calculation the percentage of solids-not-fat in the water instead of in the milk. The percentage of solids-not-fat contained in the water of milk of average quality is, of course, taken as a standard for comparison."

Butter substitutes, E. A. DE SCHWEINITZ (*U. S. Dept. Agr. Yearbook 1895, pp. 445–451*).—A historical discussion of the manufacture and sale of oleomargarine, the materials used in its manufacture, the hygienic effects of oleomargarine, possibility of transmitting infectious diseases, etc. With reference to the digestibility and physiological effect of oleomargarine, the few experiments which have been made and the opinions of various authorities are quoted. It appears from these that

there is at present some confusion of opinion on these points. A number of instances are cited in which unprejudiced persons have declared against oleomargarine after using it a short time, asserting that it caused indigestion.

Comparative studies of the germs in butter and in oleomargarine showed a much larger number in the latter, and that these were of a less desirable character.

"The writer has made a number of inoculation experiments upon guinea pigs with different samples of oleomargarine. The samples were purchased in open market near the places where they were manufactured. Sample No. 3 proved fatal, causing the death of the animal in the one instance in 2 months; in the other, in 2 weeks. An examination showed the lungs congested, the liver soft and pale, 1 of the kidneys badly congested, and 5 distinct ulcers in the intestines, like typhoid-fever ulcers. The bladder was distended and the urine albuminous. At the present writing the nature of this disease has not been determined, but the fatal effects were produced by the oleomargarine. Another guinea pig inoculated with a sample of oleo oil, taken from a lot used in the manufacture of oleomargarine, died within 3 weeks, the autopsy showing badly congested lungs, liver dark, blood vessels congested, and the small intestines containing bloody mucus.

"Five months after inoculation with another sample of oleomargarine, the pig which had been used for the experiment was chloroformed for examination. The animal was in fair condition, but the left lung showed incipient tuberculosis, and this disease was also apparent in the spleen, and there were several calcareous tubercular nodules adherent to the sternum. A preparation made from this same sample had shown the presence of a germ which could scarcely be anything but the tuberculosis bacillus. The result of the inoculation confirmed this diagnosis. The inoculations of all the animals were made by introducing in the side a bit of fat the size of a small pea. The incision healed rapidly, and at the time of the autopsies there was no evidence of local lesions or any effect which might have been due directly to the mechanical part of the inoculations.

"A number of other guinea pigs have been inoculated with different samples of oleomargarine, but at this writing (after 8 months) have not contracted disease from the oleomargarine inoculation. Two of the samples which caused disease in the animals were made at a factory where the material used may have been questionable in character.

"Our inoculation experiments show conclusively that disease may be communicated by means of oleomargarine. The objection might be raised that disease could also be communicated in the same way by butter. It is, however, a very simple and easy matter to pasteurize the cream before churning. . . . The temperature of pasteurization is unfavorable for oleo-oil manufacture. . . .

"The statements of most authorities have been to the effect that oleomargarine is good and digestible and healthful, provided it is made from pure material and the process is properly conducted. The legitimate and safe manufacture of oleomargarine can be secured, therefore, only when there is careful and safe control and inspection at the abattoirs and oleomargarine factories of both the finished product and the constituents which enter into its manufacture. Then, too, all the oleomargarine should be sold as oleomargarine, and should have something distinctive about its appearance—absence of color, as Massachusetts demands, or a specially bright color; and every pound of it should be carefully inspected at the factories before being shipped, to see that the particular distinctive character is present."

In conclusion analyses are given of a number of samples of oleomargarine and of butter. The melting point of the oleomargarine was about 10° C. lower than that of butter and several of the samples contained

considerable cotton-seed oil. The presence of an abnormally large amount of albuminoids in a number of samples of the oleomargarine "points to a contamination with animal fiber and indicates that the material used was not pure."

Butter and butter substitutes, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1895, pp. 101–106*).—The detection of adulteration of butter with oleomargarine is discussed, and analyses are given of 11 samples of butter, suspected samples, and oleomargarine.

"It is gratifying that none of the samples suspected proved to be 'oleomargarine' or 'butterine.'

"Evidently the amount of curd is not distinctive; nor is the melting point of the fats. But the figure of volatile fatty acids is only one-tenth as great in the undoubted 'oleos' as in the butters, genuine and suspected, although the genuine butters exhibit a wide range of diversity in the amount of volatile acid contained. Just as distinctly are the 'oleos' higher in their power of combining with iodin, and in their saponification equivalent."

Milk sampling, C. L. PENNY (*Delaware Sta. Bul. 31, pp. 25, figs. 2*).—Following introductory remarks on the testing of composite samples at creameries and for studying the milk of herds, the author describes observations made by him with a view to securing a milk preservative for composite tests which would dissolve the fat and carry it to the bottom of the bottle. By keeping the samples in this way it was found that the fat could be more intimately mixed with the sample when ready for analysis than is the case when the cream rises to the surface. A number of solvents were tried, but more particularly ethyl bromid, chloroform, and carbon bisulphid. The latter was found to be preferable, "on account of its low cost, its somewhat general use on the farm as an insecticide, and its antiseptic qualities when used alone."

"Samples [of milk] preserved with carbon bisulphid, in a long series of trials extending over 2 years, have withstood conditions that have shown almost every other preservative insufficient, at least in the proportion used."

Five or ten per cent of carbon bisulphid is added to the milk and a little shaking suffices to collect all the fat at the bottom. When a sample is to be taken for final analysis the milk is well mixed, there being no danger of churning, and "a perfectly homogeneous mixture is obtained."

"If the sample is to be analyzed gravimetrically for fat some care must be taken in first evaporating to avoid loss from foaming over. This evil is easily obviated in the sand method by simply puncturing the surface of the sand in several places with a platinum wire, so soon as inflation begins, after which there will be no trouble and no departure from the ordinary method. The paper-coil method requires no particular care, as the sample behaves just as fresh milk. Total solids must be determined by evaporation in sand and direct weighing; a small platinum wire may be weighed with each dish and the wire may then conveniently be used to puncture the surface as explained."

For determining the fat by the Babcock method the carbon bisulphid should be first removed. This can be done by adding 10 to 15 cc. of

80 per cent acetic acid to the milk after measuring out in the test bottles and heating to boiling, or in a water bath with air conducted into the bottles to prevent frothing. The boiling is continued until the liquid in the test bottle does not exceed the volume of milk taken, *i. e.*, 17.6 cc. The solvent action of the acetic acid on the casein at the boiling temperature is said to considerably reduce the amount of sulphuric acid necessary, so that from 13 to 15 cc. of sulphuric acid of the usual commercial strength is said to be sufficient. The test is then made in the ordinary way.

"A notable difference is seen in the quality of the results when the readings are taken. The fat now appears clearer, more transparent, and more sharply defined at the top and at the bottom than in the average test in the ordinary way. The definition, that is, the clearness of the top line and the dividing line between the fat and water, is, almost without exception, perfect. The fringe of undissolved curd at the bottom of the fat, not infrequent in the ordinary method, especially in unskillful hands, is almost never seen. The fat column is so clear that it would be apparent at sight whether it were pure fat or part curd. . . .

"While the process here described is more complicated than the ordinary test, it seems to be more certain and accurate, at least in unskillful hands. With a dozen samples to test it would require somewhat more time, but with 50 or 100 it would require very little more, as the several operations would overlap."

The results must be corrected for the carbon bisulphid added, and to facilitate this a table is given.

The results are given of a number of trials of this method of preserving the sample in comparison with gravimetric analyses. "In the practical trial of the method the results are excellent."

For measuring out the carbon bisulphid it is suggested to use a pipette connected with a bulb and having a small vent hole in one side. A shaking apparatus for shaking the test bottles after adding the sulphuric acid is illustrated and described.

The use of borax preservatives on cream-gathering routes, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1895, pp. 86–89*).—An experiment was made in which 4 teaspoonfuls of a mixture of equal parts by weight of fine dairy salt and powdered borax was mixed with nearly 3 gal. of cream, the cream subsequently churned in a small test churn, and the butter worked, salted, etc., as usual. Samples of the butter were repeatedly washed by agitation in hot water in a separatory funnel and the washings tested for borax by a delicate method, but none was found. A repetition of the trial gave the same result.

"These tests are conclusive evidence that the borax preservatives, even when used in much greater proportion than is customary on cream-gathering routes, are carried over into the butter, if at all, in quantities too small to produce any effect upon the consumer."

To the objection that the bacteria of the starter would be retarded by the preservative just as the injurious bacteria are, the author submits that "this difficulty is not a great one practically, as a slight increase in the amount of the starter or in the time of action will suffice to overcome the retarding influence of the borax."

Kephir, C. D. SPIVAK (*Repr. from N. Y. Med. Jour., 1896, Jan. 18, pp. 18*).—This is a treatise on kephir more especially from the medical point of view. Its history, preparation, composition, and the changes produced in milk in the fermentation are given, with numerous references to the literature.

"The kephir grain is a composite body made up of three different organisms: (1) *Saccharomyces cerevisiæ*, or the yeast fungus; (2) *Bacillus acidi lactici;* and (3) *Dispora caucasica* (Kern), or *Bacillus kephir* (Sorokin), a rod-shaped bacterium. The rods are united together into filaments which are closely interwoven in countless zigzags, and they are firmly connected by their tough gelatinous membrane. Notwithstanding the fact that the above-named bacteria follow the laws of their kind, yet all three take an active and equal share in the process of producing the kephir fermentation."

The therapeutic action of kephir is next discussed, and numerous instances cited of its use in various diseases. "Kephir is indicated whenever it is necessary to raise the nutrition of the enfeebled organism. The curative effect of kephir, in a limited sense, has been noticed only in certain cases of gastro-intestinal affections." In conclusion a comprehensive bibliography is given.

Inefficiency of milk separators in removing bacteria, V. A. MOORE (*U. S. Dept. Agr. Yearbook 1895, pp. 431-444, figs. 8*).—This paper discusses in a general way milk, butter, and cheese as carriers of infectious diseases; sources of milk contamination, and pasteurization and sterilization; and describes several experiments on the extent to which disease germs are separated from milk by running it through a separator. In these experiments milk was used which was artificially infected with pure cultures of the various disease germs, these being suspended in water and mixed with the milk.

Three experiments were made with milk infected with tubercle bacilli. In these experiments a large proportion of the bacilli were found in the separator slime, although bacilli were also found in both the cream and the skim milk. In one experiment in which guinea pigs were inoculated with the skim milk and with the cream all the animals died of tuberculosis within from 24 to 50 days, which "is enough to demonstrate the infectiousness of the skim milk and cream." In one case a much larger quantity of the suspension of tubercle bacilli was added.

"In 16 per cent of the preparations of the skimmed milk, and in all of those from the cream, tubercle bacilli were found. They were more numerous in the preparations made from the cream than in those from the milk. This fact affords a reasonable explanation for the statement that tubercle bacilli are frequently found in butter. As in the other experiments, the slime contained the bacilli in much larger numbers than the skimmed milk or cream."

Increasing the rapidity of the separator did not render the skim milk or cream more free from the bacilli.

Other experiments were made with milk inoculated with virulent

swine plague bacteria and hog-cholera bacilli, with results similar to those obtained with tubercle bacilli, rabbits inoculated with the skim milk and cream dying of the respective diseases.

Experiments were also made with the aid of a "hand centrifugal machine," using milk to which had been added cultures of tubercle bacilli, hog cholera, and swine plague. The results showed that the bacteria were not entirely removed by this treatment and that the milk and cream contained sufficient germs to cause the diseases in animals.

"The results of the experiments recorded in the preceding pages show that the physical conditions involved in the mechanical treatment of milk do not allow the deposition of all bacteria in the sediment. Many of the bacteria were carried over into the skim milk and into the cream. With this fact before us it is easy to understand that the butter made by the use of the separator from infected milk might contain the specific bacteria."

An experiment is recorded in which butter was made from milk to which a few cubic centimeters of a culture of hog cholera had been added, the cream being raised by a separator and the butter made in the usual way.

"Four days afterwards a rabbit was inoculated beneath the skin with 0.2 cc. of the buttermilk, and another with a piece of butter about the size of a pea. These rabbits died of hog cholera in 7 days."

In conclusion, the author believes that these experiments show that disease may be transmitted through butter and skim milk, and recommends as a remedy the pasteurization of milk intended for butter making.

On the bluing of cheese, A. HEHLE (*Molk. Ztg. Berlin, 1896, Oct. 31; abs. in Milch Ztg., 25 (1896), No. 46, p. 732*).—The cause of this trouble at a cheese factory under the author's supervision was finally traced to one herd which furnished milk to the factory. An investigation showed that it was the custom to feed the cows in the morning very sour beet diffusion residue which had stood in iron barrows over night. It is believed that the iron taken up by the acid was transmitted to the milk, and was the cause of the cheese becoming blue.

The author finds that keeping milk in rusty cans does not always result in the trouble, but only when the milk is sour. To recognize iron in milk about 5 cc. of milk is treated with a few drops of tannin solution (5 gm. tannin in 150 gm. water). If the milk turns bluish it is not used for cheese making.

The manufacture and consumption of cheese, H. E. ALVORD (*U. S. Dept. Agr. Yearbook 1895, pp. 453–474, fig. 1, dgms. 2*).—This article is devoted principally to a discussion of the production of cheese, the decline in the exportation of cheese, means by which the consumption of cheese in this country might be increased, the manufacture of skim cheese and filled cheese in the United States, and the necessity of classifying and branding cheese as a safeguard to the consumer and to the producer of high-grade cheese.

The author advocates the manufacture of small cheeses and of various kinds of fancy cheese, which he believes would tend to increase the consumption of cheese.

With reference to the necessity for improvement of domestic trade and the export of American cheese, the author says:

"Such improvement seems to depend mainly upon two conditions: First, quality; a higher standard must be set for our cheese and strenuous efforts made to induce all makers to attain to it, thus raising the average quality and securing reputation. Second, prevention of fraud; effective measures are necessary to restore confidence, so that all buyers may get with certainty what they want and pay for.

"All interests centering in cheese production demand superiority of quality and economy in production. Factory managers and cheese makers need to have the lesson impressed upon them that in honest markets the best goods are the easiest sold and the most profitable. They must be constantly on the watch for improvements and economies in manufacture. The wants of special markets and the fancies of buyers must be studied and satisfied. The British market, still our largest customer, continues to want a large cheese, rich, well cured, and firm in texture. The demand of the home market is not so fixed, but the general preference is for a smaller cheese, comparatively new, mild and rich, of medium texture and color. Following the example of Canada, the leading cheese-making States may well employ expert itinerant instructors to work at farmers' institutes, at dairy conferences, and in the factories themselves. This has already been done in New York with satisfactory results. The dairy schools established in several States are doing excellent work, and the influence of their graduates is showing itself in the dairy community at large. To these schools especially is due the credit of demonstrating the fallacy of the old idea, responsible for so much unfortunate skimming, that considerable butter fat was necessarily lost in the process of making cheese. Instead, the principle has been established that no milk is too good for good cheese, none too rich for rich cheese. . . .

"All forms of cheese, full cream, skimmed, and filled, should be so made or marked as to insure their identity all the way from place of manufacture to the consumer of the smallest fraction. Methods of accomplishing this can not be determined without the fullest consideratien of the subject. But certain points are plain. The branding and marking of packages and wrappings is not enough. Distinguishing marks should be placed upon the cheese itself. And far better than a simple stencil and easily obliterated bandage mark would be a sunken brand pressed into the top and bottom of every cheese, so that some of it would remain visible and serve for identification to the last pound of a cut cheese. This practical and effective method of marking is of Danish origin, having been successfully used there for years."

In connection with this branding it is suggested that the approximate fat content of the milk from which the cheese was made should also be indicated.

"Such a system of branding pure, whole-milk (or 'full-cream') cheese would be simple and practicable, and would result in grading the cheese product in such a way as to show at once its relative merits, proper making and curing being assumed. The grade brand should give by a single numeral the nearest whole number indicating the percentage of fat in the milk of the cheese vat, and this fact and grade should be guaranteed by the maker. The margin of one-half per cent variation, or a range of 1 per cent of fat, would be entirely safe for the manufacturer and close enough for the merchant and consumer. For full-cream cheese there would be but 3 grades—3, 4, and 5—giving a range of $2\frac{1}{2}$ to $5\frac{1}{2}$ per cent of fat, which is all that is ever found in large quantities of pure milk.

"Such a system of branding and grading being adopted, there could be no objection to extending it to skims and part skims, adding 3 more grades—0, 1, and 2."

Fixing the meaning of the terms "skim," "half-fat," "fat," and "full-cream" cheese, HERZ (*Mitt. Milchw. Ver. im Algäu, 1896, November; abs. in Milch Ztg., 26 (1896), No. 48, p. 766*).—As the result of much investigation of the soft cheese (Weichkäse) of Algau, the following classification is given:

Skim cheese.—Less than 25 per cent of fat in dry matter of cheese; 1 fat: more than 3 solids-not-fat; made from milk with less than 1.4 per cent of fat.

Half-fat cheese.—From 25 to 33.3 per cent of fat in dry matter; 1 fat: 2 to 3 solids-not-fat; made from milk with 1.4 to 2.15 per cent of fat.

Fat cheese.—From 33.3 to 44.4 per cent of fat in dry matter; 1 fat: 1.25 to 2 solids-not-fat; made from milk with 2 to 3.3 per cent of fat.

Full-cream cheese.—From 44.4 to 60 per cent of fat in dry matter; 1 fat: 0.67 to 1.25 solids-not-fat; made from milk with 3.3 per cent and more of fat.

Over-fat cheese.—Over 60 per cent fat in dry matter; 1 fat: less than 0.67 solids-not-fat; made from whole milk to which cream has been added.

The author also gives tables which show the approximate fat content (in dry matter) of cheese made from milk with all the way from 1 to 5 per cent of fat, which is given as 20.5 per cent for the cheese from the poorer milk and 56.3 per cent for that from the richer milk. The fat content of the milk left after taking various amounts of butter per 100 kg. of milk from whole milk containing 3.6 and 4 per cent of fat is also given.

The calculation of a ration for milch cows, L. GRANDEAU (*Jour. Agr. Prat., 6 (1897), I, No. 6, pp. 197–200*).

The spaying of cows, LERMAT (*Jour. Agr. Prat.; abs. in Milch Ztg., 26 (1897), No. 5, p. 73*).

The advantages of determining the fat content of the milk of individual cows of the herd, B. MORTINY (*Milch Ztg., 26 (1897), No. 1, pp. 3, 4*).

The testing of the milk of individual cows, P. VIETH (*Deut. landw. Presse, 23 (1896), No. 92, pp. 816, 817*).—A popular article on the advantages of testing the different cows of a herd, and citing some results of such tests from published accounts.

Directions for using the Babcock milk test, H. HAYWARD and M. E. MCDONNELL (*Pennsylvania Sta. Rpt. 1895, pp. 90–100, figs. 5*).—Detailed specific directions are given for testing milk, cream, and skim milk by the Babcock method, together with a list of the precautions to be observed. To aid in securing properly graduated test bottles, pipettes, and dairy thermometers the station offers to supply tested apparatus, one piece of each to each applicant, at a reasonable price.

New milk pasteurizing apparatus in Denmark, A. LAVALLE (*Milch Ztg., 26 (1897), No. 8, pp. 116–118, figs. 4*).

Cow-milking machine, M. J. CUSHMAN (*Official Gaz. U. S. Patent Office, 78 (1897), No. 12, p. 1813, fig. 1*).

Milking machines (*Milch Ztg., 26 (1879), No. 3, pp. 35–37, figs. 5*).—Illustrated descriptions of the Thistle, De Laval, and Siemsglüss machines.

Experiments with the Bergdorfer Alfa B hand separator and the new Melotte patent milk centrifugal, E. RAMM (*Milch Ztg., 26 (1897), No. 4, pp. 52–54, figs. 3*).

Centrifugal liquid separator, C. J. LUNDSTROM (*Official Gaz. U. S. Patent Office, 78 (1897), No. 12, p. 1801, fig. 1*).—A cream separator.

The treatment and use of skim milk, DE WEERTH (*Ztschr. landw. Ver. Rheinpreussen, 64 (1896), Nos. 49, pp. 409–411; 50, pp. 417–419*).—A popular article.

Loss of butter during working, R. EICHLOFF (*Milch Ztg., 26 (1897), No. 6, pp. 83, 84*).

Behavior of the different acids of butter toward fungi, T. BOKORNY (*Milch Ztg., 26 (1897), No. 2, pp. 18,19*).

Some important experiments, D. LONG (*Agl. Gaz. [London], 45 (1897), No. 1208, p. 172*).—Review of work of Wisconsin Station with Bacillus 41, and added notes.

Butter-making systems, C. T. D. ACLAND (*Agl. Gaz. [London], 45 (1897), No. 1209, p. 200*).

The action of the temperature used in the curing of cheese on the number of bacteria in the milk and the cheese, E. DE FREUDENREICH (*Ann. Soc. Micros. Belge, 1895, No. 10, pp. 445–453*).

Investigation on the course of fermentation in the manufacture of Emmenthaler cheese, C. BÄCHLER (*Schweiz. landw. Centbl., 1896, Nos. 1–4; abs. in Milch Ztg., 25 (1896), No. 33, p. 525*).

The manuafcture of soft cheeses, METALINKOFF and V. HOUDET (*Ind. Lait, 21 (1896), Nos. 49, pp. 385–387; 50, pp. 393, 394; 51, pp. 402, 403*).

Investigations of poisonous cheese, A. HOLST (*Centbl. Bakt. und Par. Med., 20 (1896), No. 4–5, pp. 160–168*).

The cheese factories of Roquefort, E. MARRE (*Prog. Agr. et Vit., 26 (1896), Nos. 41, pp. 416–418; 45, pp. 527–536, figs. 10*).

Breeds of cattle and cheese manufacture in France, P. MEYER (*Milch Ztg., 26 (1897), Nos. 5, pp. 67–71, fig. 1; 6, pp. 84–87, fig. 1; 7, pp. 97–101, fig. 1; 8, pp. 118–120, fig. 1*).

Fixing the meaning of the terms "skim," "half-fat,""fat," and "full-cream" cheese (*Deut. landw. Presse, 23 (1896), No. 98, p. 869*).—Reference to an article on this subject by Herz, noticed elsewhere (p. 834).

The Book of the Dairy: A manual of the science and practice of dairy work, W. FLEISCHMANN, translated by C. M. AIKMAN and R. P. WRIGHT (*London: Blackie & Son, 1896, pp. XXIV, 344, pls. 6, figs. 85*).—This is, for the most part, a quite literal translation of Prof. Fleischmann's *Lehrbuch der Milchwirthschaft*, published in 1893, with a short introduction by the translators, and occasional additions. The text of the German edition has for the most part been closely adhered to, even to the minute details so characteristic of the original. The apparently conscientious effort to reproduce in English as nearly as possible the exact language of the German author has resulted in many involved statements, which often do not convey exactly the author's meaning, and are not easy to read or understand. At times the translation verges on the ludicrous, as in the chapter heading where "extraction" of milk is used to mean milking, and also in the heading "Preparation of keeping milk," meaning milk which has been pasteurized, sterilized, condensed, etc., called *Dauermilch* in the original.

The part of the translation relating to methods of analysis frequently suggests a lack of familiarity with the subject, and the directions given, though sufficiently detailed, would not be intelligible to one unfamiliar with the methods. For instance, in determining milk sugar gravimetrically, after the treatment with Fehling's solution, the following directions are given for preparing the filter tube and filtering the reduced copper: "A small, straight, calcium chlorid tube, whose bulb is half *protected* [filled] by oblique and not too soft asbestus filaments, is washed, then dried. . . . Filtration is then carried on by pouring through an attached glass funnel *in the presence of a weak diluted atmosphere* [meaning with the aid of a filter pump]. . . . Thereafter the filter tube is removed, *stretched*, and, after the ether has been for the most part expelled by air, *bent on a holder downwards*," etc. (The italics are ours.)

The numerous references to original papers given in the German edition have been omitted, which will be a matter of regret to a certain class of readers at least. Careful editing of the translation should have eliminated many of its Teutonic peculiarities, and might with advantage have condensed the text in places, and adapted it in a measure to English and American readers.

But in spite of these criticisms it should be said that the book is the most complete treatise on the subject in the English language, and will be welcomed by many who have long felt the need of a comprehensive book on the science and practice of dairying.

AGRICULTURAL ENGINEERING.

Climate, soil characteristics, and irrigation methods in California, C. W. IRISH (*U. S. Dept. Agr. Yearbook 1895, pp. 475–486, pls. 2, figs. 5*).—A table is given showing the seasonal rains of California during the period from 1849 to 1890, and the distribution of rainfall in the Sacramento and San Joaquin Valleys and on the deserts of California is discussed, as well as the character of soil of the irrigated districts, the amount of water used, and the methods of irrigation, including flooding, irrigating by basins or checks, and irrigating by furrows.

Coöperative road construction, R. STONE (*U. S. Dept. Agr. Yearbook 1895, pp. 487–492*).—The community of interests in road construction, national and State aid, legislation favoring the coöperative system, the best road for farming districts, the use of convict labor, and the necessity of coöperation are discussed.

It is stated that "current thought and feeling in the United States regarding the improvement of highways is setting steadily toward a recognition of the common interest of all classes of citizens, wherever located, and of all capital, however invested, in good roads."

Road making and repairing, G. E. MORROW (*Oklahoma Sta. Bul. 21, pp. 13–16*).—General suggestions regarding road making and repairing under Oklahoma conditions.

STATISTICS.

Reports of the treasurer and director of Maine Station for 1895 (*Maine Sta. Rpt. 1895, pp. 5–9, 127–143*).—Statement of receipts and expenditures for the fiscal year ending June 30, 1895; summary of work of the year, and reprints of bulletins issued.

Eighth Annual Report of Nevada Station, 1895 (*Nevada Sta. Rpt. 1895, pp. 23*).—Notes are given upon progress of work during the year by the director and heads of departments of the station, and a financial statement for the fiscal year ending June 30, 1895.

Financial statement and report of director of Pennsylvania Station, 1895 (*Pennsylvania Sta. Rpt. 1895, pp. 7–16, 226, 267*).—Financial statement for the fiscal year ending June 30, 1895; general notes by the director on lines of work, personnel, and publications of the station, and list of exchanges.

Work of the Department of Agriculture as illustrated at the Atlanta Exposition, R. E. WAIT (*U. S. Dept. Agr. Yearbook 1895, pp. 503–522, pls. 3, dgm. 1*).—An interesting and comprehensive account of the exhibits made at the Atlanta Exposition by the various bureaus, divisions, and officers of this Department.

Yearbook of the Department of Agriculture 1895 (*U. S. Dept. Agr. Yearbook 1895, pp. 656, pls. 10, figs. 134*).—This includes the report of the Secretary of Agriculture covering the fiscal year ending June 30, 1895; numerous semipopular articles noted elsewhere; and an appendix containing "a large amount of miscellaneous information taken from the reports of this Department and presented with especial regard to the requirements of the agricultural reader. Statistics of agriculture taken from the reports of the Census, and much interesting information relative to

the exports, imports, and per capita consumption of agricultural products from the publications of the Bureau of Statistics of the Treasury Department have also been compiled in convenient form down to the latest available data."

Rothamsted, J. MACDONALD (*Trans. Highland and Agl. Soc. Scotland, 7 (1895), pp. 1-10, pls. 3, figs. 2*).—A brief historical account of the Rothamsted Experiment Station and its founder.

The Rothamsted experiments, J. B. LAWES and J. H. GILBERT (*Trans. Highland and Agl. Soc. Scotland, 7 (1895), pp. 13-354, figs. 2, pl. 1, dgms. 2*).—This is "an account of some of the results of the agricultural investigations conducted at Rothamsted in the field, the feeding shed, and the laboratory over a period of 50 years," and is practically the same as the account given in Bulletin No. 22 of this Office (E. S. R., 7, pp. 380, 385, 415).

Agricultural teaching at Oxford, J. SIBTHORP (*Nature, 55 (1897), No. 1428, pp. 449, 450*).

The Swiss agricultural high schools (*Deut. landw. Presse, 24 (1897), No. 10, pp. 76, 77, figs. 3*).

A study of the agricultural and industrial conditions in Egypt, C. PENSA (*Ann. Agron., 22 (1896), II, No. 3, pp. 323-409, pl. 1*).

A pioneer in agricultural science, W. P. CUTTER (*U. S. Dept. Agr. Yearbook 1895, pp. 493-502, fig. 1*).—This is a historical account of the services rendered to agriculture by Edmund Ruffin, who was born in Virginia in 1794. He was a strong advocate of the use of lime, and based his opinion on experiments conducted by himself as well as on the writings of others.

"His reasons for the use of marl, gained from his experience and study, were two in number. He believed that the addition of marl corrected the natural acidity of the soil, and that it assisted in the preservation of organic manures from loss of the gaseous products of decomposition while hastening the decomposition itself. He foreshadowed to a great degree the discoveries of later years with reference to the action of soil bacteria; for, as is now well known, certain of the nitrifying organisms in the soil are capable of action only in neutral or alkaline soils, and thrive best in the presence of a small amount of alkali. . . .

"Edmund Ruffin conducted his experiments with such attention to details and with such a truly scientific method of preparation and planning that we may look on his work as some of the best done in the country. He certainly was ahead of the investigators of the day. He proved by experimentation not only that the practice of the farmer is often ahead of the proof of the theorist, but that the work of the theorist is often of great practical benefit to the farmer."

NOTES.

ARIZONA STATION.—John H. Martin, of Tucson, has been appointed a member of the governing board, *vice* E. R. Monk. The station will conduct quite extensive experiments with sugar beets during the present season, with coöperative experiments throughout the Territory.

IDAHO COLLEGE AND STATION.—The substations at Grangeville, Idaho Falls, and Nampa have been discontinued and the personal property removed to the station at Moscow. The newly organized governing board is constituted as follows: J. H. Forney, of Moscow, president; F. Martin, of Boise, vice-president; J. G. Brown, of Pocatello, secretary; P. A. Regan, of Boise, treasurer; F. E. Cornwall, of Moscow; D. M. Eckman, of Vollmer; Mrs. M. J. Whitman, of Montpelier; A. Turney, of Idaho City, and A. F. Parker, of Grangeville.

L. F. Henderson and J. M. Aldrich, botanist and entomologist, respectively, of the station, have been appointed members of the State board of horticultural inspection. A law for the extermination of insects and weed pests was passed at the recent session of the legislature and provisions made for the inspection of the fruit trees exposed for sale, the orchards, and the fruits in the market, with a view to preventing the spread of insect pests.

IOWA COLLEGE AND STATION.—James Wilson has been granted indefinite leave of absence to assume the duties of Secretary of Agriculture. C. F. Curtiss has been chosen director and professor of agriculture, James W. Wilson and Charles D. Reed assistants in agriculture, and Joseph J. Edgerton instructor in agricultural physics.

OKLAHOMA COLLEGE AND STATION.—Dale Lytton, of Stillwater, has been appointed a member of the board of regents of the college, *vice* S. H. Kelsey. The other members of the board have been reappointed.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vols. I to VII, with indexes; Vol. VIII, Nos. 1–9.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of Stations and Colleges, 1892; No. 13, Organization Lists of Stations and Colleges, 1893; No. 14, Proceedings of Convention of National League for Good Roads, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of Stations and Colleges, 1894; No. 20, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of Stations and Colleges, 1895; No. 24, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of Stations and Colleges, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of Association of Agricultural Colleges and Experiment Stations, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University in 1895; No. 33, The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses; No. 34, The Carbohydrates of Wheat, Maize, Flour, and Bread, and the Action of Enzymic Ferments upon Starches of Different Origin; No. 35, Food and Nutrition Investigations in New Jersey in 1895 and 1896; No. 36, Notes on Irrigation in Connecticut and New Jersey; No. 37, Dietary Studies at the Maine State College in 1895; No. 38, Dietary Studies with Reference to the Food of the Negro in Alabama in 1895 and 1896; No. 39, Organization Lists of Stations and Colleges, 1897; No. 40, Dietary Studies in New Mexico in 1895.

Miscellaneous Bulletins.—Nos. 1, 2, and 3, Proceedings of Association of Agricultural Colleges and Experiment Stations, January and November, 1889, and November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates; No. 48, The Manuring of Cotton; No. 49, Sheep Feeding; No. 56, Experiment Station Work—I.

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beat

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII

No. 10

EXPERIMENT STATION RECORD

WASHINGTON
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1897

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
WALTER H. EVANS, PH. D.—Botany and Diseases of Plants.
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R. A. EMERSON—Horticulture.
J. I. SCHULTE—Field Crops.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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SUBJECT LIST OF ABSTRACTS.

CHEMISTRY.

LIST OF PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

VOL. VIII. No. 10.

The act of Congress making appropriations for the United States Department of Agriculture for the fiscal year ending June 30, 1898, carries the following general items: For the Office of the Secretary, $87,100; Weather Bureau, $883,702; Bureau of Animal Industry, $755,640; Agricultural Experiment Stations, $755,000, including $30,000 for the Office of Experiment Stations and $5,000 to "investigate and report to Congress upon the agricultural resources and capabilities of Alaska, with special reference to the desirability and feasibility of the establishment of agricultural experiment stations in said Territory, as has been done in other States and Territories, and the selection of suitable locations for such stations;" Division of Statistics, $145,160, including $10,000 for continuing the investigations on foreign markets; Division of Botany, $23,800; Division of Agrostology, $18,100; Division of Forestry, $28,520; Division of Pomology, $14,500; Division of Vegetable Physiology and Pathology, $26,500; Division of Biological Survey, $27,560; Division of Entomology, $29,500; Division of Chemistry, $29,500; Division of Soils, $16,300; Nutrition Investigations, $15,000; Fiber Investigations, $5,000; Public-Road Inquiries, $8,000; Division of Seeds, $130,000; Division of Publications, $85,260, of which $35,000 is for Farmers' Bulletins and $10,960 for the Document Section; Division of Accounts and Disbursements, $16,300; Experimental Gardens and Grounds, $27,500; Library, $13,960; Museum, $4,000; furniture, cases, repairs, postage, and contingent expenses, $37,000.

The total appropriation under this act is $3,182,902. To this amount may be added $85,000 available for printing and binding the miscellaneous publications of the Department, and the appropriation for printing the Yearbook of the Department, amounting to about $300,000. Both of the latter funds are contained in the general appropriation for printing.

Of the Department appropriation proper, approximately $1,170,000 is for use directly in conducting scientific investigations in agriculture under the immediate supervision of the Department. Adding to this the $720,000 for maintaining agricultural experiment stations in the several States and Territories, gives the munificent sum of $1,890,000 appropriated by the Federal Government for the promotion of agriculture by means of investigation and experimentation during the year 1897–'98, an amount which far exceeds that appropriated by any other Government in the world for this purpose.

The scientific basis upon which the best and most economical methods of managing barnyard manure rest has claimed much attention recently from a number of the most prominent scientific men of the old world. The present and the preceding numbers of the Record contain abstracts of reports on this subject by Dehérain, Dietzell, Maercker, Wagner, Pfeiffer, and others. A recent number of *Die landwirthschaftlichen Versuchs-Stationen* is devoted exclusively to the subject, and French and other foreign agricultural journals are giving much space to it. Recent effort has been very largely directed to the practical end of simplifying methods of management and preservation, for it is clearly understood that only the fertilizing matter of barnyard manure is in so dilute and bulky a form that only the simplest methods of manipulation can be profitably applied to it.

The object sought is a very simple and definite one, but the means by which it is to be attained must be developed by scientific investigation of the most complex and comprehensive kind. The changes which manure undergoes, which it induces in the soil, and which determine to a large extent its fertilizing value, are mainly the work of microörganisms. A study of these changes therefore requires not only most careful work on the part of the chemist, but also painstaking study on the part of the bacteriologist; and since the conclusions reached by these experts must be confirmed by actual tests in the field, the investigation of this subject furnishes an opportunity for profitable coöperative work by at least three departments of an experiment station.

Since the direct fertilizing value of manure depends so largely on the nitrogen which it contains, it will be found that the investigators above referred to have given their attention mainly to a study of the availability, changes, and causes and prevention of loss of this element in manure.

Probably the most interesting fact brought out is that coarse manure and litter, especially wheat straw, contain an active denitrifying organism. It has been observed that when such material is liberally applied to the soil the available nitrates present are converted into unavailable forms, the application of manure resulting in many cases in a decreased rather than an increased yield of crop. It has been shown, however, that this effect is not likely to be noted unless manure is applied in unusually large amounts. Still, this is a subject of great scientific importance, and demands that in the study of methods of management of manure the effort should be made to develop systems of preservation which will not only prevent harmful changes in the nitrogen, but also reduce to a minimum the activity of the denitrifying organisms, which may prove so injurious in the soil.

A REVIEW OF PUBLICATIONS ON AGRICULTURAL BOTANY ISSUED IN FRANCE DURING 1896.

Edmond Gain,

Dean of the Faculty of the University of Nancy (France).

The extended adoption of field tests has done much to promote the introduction of scientific methods into practical agriculture. There is no comparison between the system of agricultural education in France twenty years ago and that found to-day. The support given the Agricultural Institute of Paris has enabled it to train teachers of agriculture for the different provinces of France, and these have had an important influence in improving the condition of the farmers, aiding them with scientific information relating to the improvement and cultivation of the soil, the selection and testing of seed, the use of fertilizers, and the treatment of plant diseases and insect enemies. Within the past two or three years courses in agriculture have been established in many of the colleges, and the number of special schools of practical agriculture is increasing, as well as the number of students in such courses. At the same time the number of publications relating to agricultural botany has increased. There is a necessity, however, for the establishment under proper restrictions of courses of agricultural education in the larger universities. While there are many stations for chemical analysis of soils and fertilizers in France, there are but two or three for investigation in vegetable pathology and for seed testing, and as a result French literature shows a scarcity of works upon these lines.

A periodical résumé of the work published along different lines of investigation will serve to show what is being done and what could be profitably undertaken. In the present paper a review is given of the publications appearing in France during the past year upon agricultural botany, the literature being classified under the following heads: Physiological botany, vegetable chemistry, vegetable pathology, culture, and vegetable products. More than 200 publications on these topics are noted.

VEGETABLE PHYSIOLOGY.

Through the work of Liebig and Boussingault we know the mineral elements entering into the structure of plants. Raulin[1] in his studies on *Aspergillus niger* determined the elements which are essential to growth and the relative importance of each in influencing the increase

[1] Ann. sci. nat. Bot., ser. 5, 11 (1869), p. 190.

in weight of plants. The same author[1] has supplemented his earlier work by his investigations on the influence of different proportions of fertilizing elements upon increase in weight. He found that unless the total amount of fertilizing materials was excessive, an excess of one constituent over another was not detrimental, since part of the excess was not used by the plant. Part of the constituent is used to increase the yield of the crop, but not as much as would have been taken up had it been present in proper proportion. Yields of plants may be increased by increasing the amount of complete fertilizers applied up to a certain limit. This limit, however, is rather high, it being possible to increase twenty times the amount of fertilizer commonly used. The increase in yield is at first nearly proportional to the increased amount of fertilizer applied, but gradually becomes less and less, until it disappears and the fertilizer becomes injurious. Plants in poor soil are better adapted to the utilization of small quantities of fertilizers than large amounts. A natural soil gives up its fertilizing materials very slowly, and so its reserve of fertility may be retained for a long time.

The conclusions of Raulin's work explain some facts often observed in practice, notably that good results on poor soils follow the application of small quantities of chemical fertilizers.

The question of the nitrogen nutrition of plants has received much attention. Müntz[2] has studied the extent to which atmospheric ammonia aids in the nutrition of plants. Schlössing in 1874 demonstrated that gaseous ammonia may be absorbed by leaves. The recent work of Müntz shows that astringent substances in the plant, acid salts, and free acids are able to fix ammonia. The amount of atmospheric ammonia taken up annually per hectare is about 10 kg. for maize and artichokes and 2 to 3 kg. for oats, sugar beets, and grapevines and an equal amount of nitrogen is carried down in the rain water, but this does not indicate that nitrogenous fertilizers may be dispensed with. Ammonia once fixed is not liberated, but enters into the processes of synthesis under the influence of light. This phenomenon is associated with respiration and assimilation.

The ammonia of the air does not play a very important rôle, but this is not true of the free nitrogen of the air. Continuing the researches of Berthelot, Hellriegel, Wilfarth, Winogradsky, Dehérain, and Schlössing and Laurent, R. Bouilhac[3] has studied the fixation of atmospheric nitrogen by bacteria and algæ. His experiments show that *Schizothrix lardacea* and *Ulothrix flaccida* are unable to grow in nutrient solutions lacking nitrogen, even when associated with various soil bacteria. On the other hand, *Nostoc punctiforme* is able to fix free nitrogen. This plant compares with the Leguminosæ in being especially rich in

[1] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 404.
[2] Ibid., p. 161.
[3] Compt. Rend., 123 (1896), p. 828.

nitrogen. It seems possible that within a few years we shall know the rôle of free atmospheric nitrogen in the nutrition of many of the lower plants.

L. Mangin,[1] whose early investigations on respiration are well known, has continued his experiments, studying the effect of abnormal respiration. Experiments conducted with plants in an atmosphere containing an excess of carbon dioxid and a deficiency of oxygen showed that respiration and growth were notably checked. This is true of plants whose seeds have an oleaginous reserve rather than of starchy seeds. The same author[2] in his studies on the growth of plants in relation to soil aëration has obtained results applicable to tree planting in large towns, namely, that compacted soils are less aërated than those covered with asphalt. Under the influence of irrigation which renders soil more compact, the quantity of carbon dioxid in the soil atmosphere may increase to 16 to 24 per cent. The experiments of Jentys, Boehm, and others have shown that 4 per cent of carbon dioxid in the soil is detrimental to the growth of many plants. The author constructed apparatus for taking samples of the air of the soil and made numerous examinations of it which are reported. He reviews the work of agronomists and hygienists, and discusses the Flemish and Vienna tile drainage systems of aëration and recommends (1) the use of such systems in connection with a system of deep drainage and (2) that in case of very fine humus soil stones and gravel be applied in order to increase the permeability of the soil and diminish the evil effects of packing. By this procedure it is thought that the mortality of the trees of parks and promenades, which in Paris annually amounts to 17 per cent for chestnut trees, 2.3 per cent for plane trees, 3.6 per cent for locusts, and 6 for lindens, might be reduced to from 0.5 to 2 per cent.

W. Palladine[3] has continued his work on the correlation between the respiration of plants and their content of nitrogenous substances. For a given temperature and with a sufficient quantity of carbohydrates the ratio between the amount of carbon dioxid given off by many plants in an hour and the quantity of undigested nitrogen is constant. Research of this nature will be more useful later, when our knowledge of organic synthesis is more advanced. A. Bach,[4] in his work on the chemical mechanism of the reduction of nitrates and the formation of quaternary nitrogenous compounds, has shown how little we know of this subject. Formaldoxime is evidently the first quaternary compound in the reduction of nitric acid by formic aldehyde, but the ultimate formation of formamid is not demonstrated.

Duclaux[5] in his investigations on solar action has opened up a new

[1] Compt. Rend., 122 (1896), p. 747.
[2] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 1.
[3] Rev. gén. Bot., 8 (1896), p. 225.
[4] Compt. Rend., 122 (1896), p. 1499.
[5] Ann. Inst. Pasteur, 10 (1896), p. 129.

field in vegetable physiology. According to his conclusions there are certain biological effects of light which demand examination. The direct action of light upon certain physiological phenomena is but little known.

C. Flammarion[1] has reported the results of investigations on the effect of different colors on the growth of plants.

Mesnard[2] has shown the influence of light on the liberation of the perfume of flowers. According to his results light, and not oxygen, is the principal cause of the transformation and destruction of perfumes. The intensity of the perfume of a flower at any given time depends upon the equilibrium established between the pressure of the water in the cells which tends to expel the perfume already contained in the cells of the epidermis and the action of the light which combats this turgescence. In the memoir giving the detailed results[3] as well as in previous papers[4] numerous graphic curves are given which show the influence of the factors which determine the intensity of perfumes. The results are applicable where plants are grown for their perfume.

Another memoir worthy of attention is that of Maquenne[5] on the rôle of osmosis in plants. All soluble bodies accumulate at points in the living organism where there is a lowering of the osmotic pressure. The accumulation of sugar in beets is explained by the author. Certain experiments of Pfeffer[6] have been utilized to indirectly measure the forces developed by seed while swelling. Morosow[7] has thrown some light on the chemical changes in germinating seed by his studies on the decomposition of albuminoids during germination. He combats the opinions of Borodine and Pfeffer, accepting Boussingault's conclusion that asparagin is an excretory product. He shows the retarding influence of nonnitrogenous materials and the accelerating effect of calcium salts on the decomposition of the albuminoids of seed during their germination.

Numerous experiments have been conducted to ascertain the effect of electricity on plant growth, but the results have often been contradictory. It seems, however, that plants derive some benefit from the action of electricity. Thouvenin[8] has made investigations in this line which may be of great value in greenhouse culture. In his preliminary investigations he undertook to establish the effect of continuous electric currents on the decomposition of carbon dioxid by plants. The organic matter of plants is about 50 per cent carbon, and it is therefore interesting to see the effect of electricity on the assimilation of carbon.

[1] Bul. Min. Agr. France, 15 (1896), p. 273 (E. S. R., 8, p. 26).
[2] Compt. Rend., 122 (1896), p. 491.
[3] Rev. gén. Bot., 8 (1896), pp. 129, 203.
[4] Ann. sci. nat. Bot., ser. 7, 18 (1893), p. 257; Rev. gén. Bot., 6 (1894), p. 97.
[5] Ann. Agron., 22 (1896), p. 5.
[6] Compt. Rend., 123 (1896), p. 898.
[7] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 425.
[8] Rev. gén. Bot., 8 (1896), p. 433.

According to the author, this assimilation is favored through the accelerated decomposition of carbon dioxid. His later results indicate that the electric current has an influence on respiration. Considering the ease with which electric currents may be applied, it is surprising that these experiments have not been multiplied with a view to their practical application in the growth of crops. For a well-equipped station this is a profitable line of investigation.

One of the most important publications of the year is that of Berthelot and André[1] on recent investigations on the growth of plants. The general study of the formation of organic matter—that is, the gradual fixation of carbon, hydrogen, oxygen, nitrogen, and the mineral compounds—has been considered by the authors[2] in a previous paper. In this the problems and methods of analysis are stated, and it is shown how it was possible to chemically define the plant at the different periods of its growth. An attempt is made to establish "a general equation for the plant" and its successive growths both with respect to elementary composition and proximate constituents. This is one of the first attempts to make an exact chemical study of the plant in its entirety and to determine the relative weights of its various parts and constituents in comparison with the total. The results of 4 years' experiments at the station for plant chemistry at Meudon are reported. The plants grown were white lupine, wheat, alfalfa (annual except in one series in which it was grown from old roots), and black locust with which only those parts removed each year, such as leaves, flowers, and fruits, were taken into account.

In these experiments both the proximate and the ultimate constituents were determined. The plants were analyzed at different fundamental periods in their development, viz, seed, first leaf, flowering, fruiting, and maturity. From the analytical data it is possible to compute the atomic relations in terms of 6 atoms of carbon, according to the hypothesis that the greater part of the insoluble matter in plants is made up of compounds containing C_6. The conclusions reached by the use of this method were that the relative and absolute amount of carbon is greatest in the leaves. In the roots and stems the relative amount of carbon is the same, while the absolute amount is considerably larger in the stems than in the roots. The relative amount of hydrogen is greatest in the leaves and least in the stems. The stems, then, must be considered the seat of oxidation, while the leaves are in a continual state of reduction. Moreover, in the leaves is found the greatest absolute amount of hydrogen and the minimum in the roots. The relative and absolute amounts of albuminoids are greatest in the leaves, least in the stems, and intermediate in the roots. From this it would appear that the most rapid oxidation goes on in the stems, less in the roots, and least of all in the leaves. There is shown to be an excess

[1] Ann. Chim. et Phys., ser. 7, 9 (1896), pp. 5, 145.

[2] Ann. Chim. et Phys., ser. 6, 5 (1885), pp. 385, 392.

of total hydrogen over that in the carbohydrates in the different parts of the plant. This excess is least, $\frac{1}{17}$, in the stem; more marked, $\frac{1}{6}$, in the root; and $\frac{1}{2}$ in the leaves. If from the total hydrogen the amount of hydrogen represented by the amids and carbohydrates be subtracted, the excess in the roots is equal to about $\frac{1}{4}$ of that in the amids and $\frac{1}{30}$ of the total hydrogen. In the stems there may be no excess or even a deficiency. This implies a disappearance of fatty substances and a degree of oxidation surpassing that of the carbohydrates. In the leaves the excess of hydrogen is nearly equal to that of the amids and 4 times as great as the hydrogen in the carbohydrates. The proportion of albuminods to nonnitrogenous matter is lowest in the stem—1:7, 1:4 in the root, and 1:2 in the leaves, showing that the nitrogenous material is partially oxidized in passing through the stem and restored to its original form in the leaves.

These results were obtained during the earlier stages of vegetative growth when the processes of growth were very simple and were not complicated by the more complex processes accompanying reproduction.

The results for the other stages of plant growth are tabulated and briefly summarized by the authors, as well as data for the variations in the principal fertilizing constituents in the plant (phosphoric acid, potash, lime, etc.). The general conclusions of Berthelot and André relating to the variation in the weight of lupines agree with those of Jumelle[1] in his work on the development of annual plants, and those more recently graphically presented by Gain.[2] At the outset the variation in weight is slight, and there is some loss of organic material, while on the contrary there is a considerable gain in mineral constituents. The fats are partly consumed, lime and potash increase considerably, and the phosphorus diminishes. The weight of the plants quadrupled in the first 3 weeks by simple nutrition, the organic material increasing much more rapidly than the mineral matter. At this stage the roots formed $\frac{1}{9}$ the weight of the plant and contained the maximum amount of mineral matter. The production of carbohydrates was more rapid than that of the nitrogenous principles. The mineral constituents, especially potash, increased. During the next 3 weeks, until the time of flowering, the weight of the plant again quadrupled. The distribution of the mineral matter was greatly modified and the proportion diminished. During the 2 weeks of flowering growth was very slow and was confined to the production of organic matter, which is subsequently used in fructification.

For wheat the progress of vegetation was identical with that of lupines. In the same manner the authors have reported upon the processes of growth in alfalfa and the black locust.

Attention is called to the work of Leclerc du Sablon[3] on the formation of nonnitrogenous reserve matter in walnuts and almonds, and that

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[1] Rev. gén. Bot., 1889.

[2] Ann. sci. nat. Bot., ser. 7, 20 (1895), p. 63.

[3] Compt. Rend., 123 (1896), p. 1084.

of Coupin[1] on the absorption and transpiration of water by seed both at the time of swelling and at maturity. Numerous experiments are described and graphic curves obtained with an automatic registering apparatus are given.

E. Gain[2] has described a method of seed selection based upon the observation that the most fertile soils do not produce seed that are the most prolific. Raulin[3] has demonstrated experimentally that one of the factors in seed variation is changing the soil with each generation. A change in the chemical nature of the soil is beneficial, the maximum and minimum influence depending upon the order of succession of the different types of soils, such as humus, sand, clay, and calcareous. Hence, in the selection of seeds the general character and the chemical nature of the soil on which they were produced should be taken into account, for it is believed that to this factor is due the various cultivated races. Parmentier[4] has established certain general rules for recognizing the parentage of certain long-established races and for finding the original stock of a variety. He studied the anatomical characters qualitatively and quantitatively, and was able in many cases to distinguish doubtful and disputed species in this way.

In the domain of anatomy and experimental physiology especial attention is called to the work of C. Dassonville[5] on the action of salts on the form and structure of plants. The results obtained are capable of direct application to agriculture. The experiments were made with lupines, rye, wheat, maize, potatoes, buckwheat, hemp, flax, colza, etc. Water cultures were made by Knop's method, and controlled by check cultures in soil, by withholding or adding successively different salts, such as calcium nitrate, nitrate of potash, phosphate of potash, and sulphate of magnesia. Interesting results bearing upon the anatomical structure of the resultant plants were obtained. They throw new light upon the question of the evolution of plant forms under the influence of environment.

Finally, attention is called to the work of Clos[6] on the external characteristics of the tubercles of Leguminosæ and the mode of distinguishing between them, which concludes his work on the revision of the tubercles of the Leguminosæ.[7]

PLANT CHEMISTRY.

The subject of plant chemistry will be considered under 3 heads, physiological chemistry, general chemistry of plants, and analytical chemistry.

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[1] Ann. sci. nat. Bot., ser. 8, 2 (1896), p. 129.

[2] Rev. gén. Bot., 8 (1896), p. 303 (E. S. R., 8, p. 288).

[3] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 311 (E. S. R., 8, p. 288).

[4] Second memoir, Compt. Rend. Congr. Soc. Savantes, Sec. Sciences, 1896, Bot., pp. 44, 128. 3d memoir, Ann. sci. nat. Bot., ser. 8, 2 (1896), pp. 1–36. First memoir, Soc. d'Acclimation du Doubs, 1895.

[5] Rev. gén. Bot., 8 (1896), pp. 284, 324.

[6] Compt. Rend., 123 (1896), p. 407.

[7] Mem. Acad. Sci. et Lettre Toulouse, 1893.

Physiological chemistry.—A question of great importance in physiology is the origin of the nitrogenous principles of plants. The oxidation of organic matter, especially nitrification, is an important subject for investigation.

Dehérain and Demoussy[1] have continued their investigations upon the maximum activity of ferments under the combined influence of heat and humidity. In vegetable mold this maximum was reached with a water content of 17 per cent and a temperature ranging from 22 to 44° C. and in garden soil with 25 per cent water and 22° C. At 44° the activity of the bacteria was checked, providing the water content of the soil remained constant at from 17 to 25 per cent.

Marcille,[2] in his investigations on nitrification, found, as had already been shown by Winogradsky, that the activity of the ferments varied in different soils. In studying the comparative nitrification of phosphate and sulphate of ammonia he found that the phosphate was no more favorable to the action of the nitrous ferment than the sulphate, but that it did seem to favor the transformation of nitrites into nitrates. Bréal[3] has investigated the decomposition of vegetable matter in the presence of water and soil. He made a study of vegetable infusions found in soils rich in organic remains. Water in contact with decaying vegetation becomes crowded with bacteria, which attack the vegetable matter and produce ammonia. The excess of ammonia checks the activity of the microörganisms. In no case did the organisms produce more than 0.2 gm. of ammoniacal nitrogen per liter in the infusions. When an infusion containing these organisms is incorporated in a lump of soil the ammonia is transformed into nitric acid at the surface, while ammonia accumulates at the center, since the organism is incapable of activity in the absence of air. There is also a reduction of the nitric acid produced. A soil which has already nitrified the ammonia in an infusion with which it has been watered is, on that account, more able to nitrify more ammonia, the activity of the nitric ferment seeming thus to be accelerated. Humus, which is insoluble in water, dissolves in these infusions on account of the ammonia secreted. The insolubility was restored by the introduction into the infusion of the nitric ferment contained in the soil.

Less ammonia and more nitrate are found in a soil that has been mixed with vegetable débris than in the same soil if the litter is simply spread upon the surface. When the ammonia in these infusions becomes sufficiently strong to kill the organisms producing it fungi develop on the surface and transform the ammonia into nitrogenous organic compounds. In meadows, peat beds, and in vegetable débris which accumulates in humid soils the nitric ferment is not present, but fungi of various kinds abound. Ammonia is taken up by the fungi

[1] Ann. Agron., 22 (1896), p. 305.

[2] Ibid., p. 337 (E. S. R., 8, p. 569).

[3] Ibid., p. 362 (E. S. R., 8, p. 479).

and the organisms which produce ammonia are capable of continuing their activity, the fungi having removed the ammonia which checks or destroys the activity of the organisms producing it. These conclusions show the complexity of the phenomena produced by the organisms of the soil and the difficulty of regulating them.

The reduction of nitrates in arable soils has been studied by Bréal,[1] and according to him the simple settling of soil should transform it from a nitrifying to a denitrifying medium, and inversely the addition of vegetable substances by lightening and separating the soil should increase the activity of nitrifying organisms. It has been found, however, that, on account of the so-called straw ferment,[2] the addition of straw to the soil may result in denitrification. This is also the opinion of Wagner[3] concerning the activity of denitrifying ferments. The experiments of Pagnoul and Dehérain are in the same line.

Among the investigations of the chemical phenomena owing their action to the intervention of soluble ferments produced by the plant may be mentioned the work of Bertrand[4] on the latex of *Rhus* spp., on laccase and its oxidizing power,[5] and the investigations on the occurrence of laccase in plants.[6] He found laccase in the roots of beets, carrots, turnips, and dahlias; in the tubers of potatoes and artichokes; in the leaves of clover, beets, alfalfa, etc., and in the fruit of apples, quinces, etc.

This widely distributed ferment has also been studied by Bourquelot,[7] who has shown that laccase is a new type of diastase characterized by its strong oxidizing power, this property explaining the formation of certain perfumes of plants. The rôle of oxidizing ferments[8] is very important from the standpoint of the chemical dynamics of the plant, and is a subject worthy of extended study.

De Rey Pailhade[9] has shown the simultaneous existence of two oxidizing ferments, the laccase of Bertrand, which oxidizes tincture of guaiacum, and the ferment of Rohman and Spitzer, which produces indophenol in the presence of naphthol and paraphenylenediamin in solution.

Bertrand and Mallèvre[10] have shown the occurrence of pectase in the plant world. It would be of interest to pursue further the question of vegetable digestion as suggested by the work of V. Poulet.[11]

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[1] Ann. Agron., 22 (1896), p. 32 (E. S. R., 7, p. 663).
[2] Compt. Rend., 114 (1892), p. 681 (E. S. R., 3, p. 916).
[3] Deut. landw. Presse, 22 (1895), pp. 91, 98, 123.
[4] Compt. Rend., 118 (1894), p. 1215.
[5] Compt. Rend., 120 (1895), p. 266.
[6] Compt. Rend., 121 (1895), p. 166.
[7] Bul. Soc. Biol., ser. 10, vol. 3, p. 315.
[8] Ann. Agron., 22 (1896), p. 116.
[9] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 153.
[10] Moniteur Quesneville, 12 (1896), p. 215.
[11] Compt. Rend., 123 (1896), p. 356.

Henry[1] has published a bibliography and the conclusion of his investigations on tannin in wood begun in 1887. He studied 28 species and has located the tannin in the bark, sapwood, and inner wood of the plant, and has shown the amounts present in each case.

E. Mer[2] has reviewed the question of the formation of duramen. In the course of its development the duramen fixes the tannin which impregnates the woody fibers of the older layers. The tannin gradually oxidizes and thus imparts to the duramen its characteristic reddish brown tint.

Gaston Bonnier[3] made some experimental investigations on the subject of honeydew. The more common honeydew—that produced by aphides and other insects—is levorotatory. There is a honey of vegetable origin which differs from that produced by insects in its method of production, diurnal variation, and chemical composition, and which is very similar in character to the nectar of flowers.

Other works merely to be cited here are those of G. Clautriau[4] on a chemical study of the glycogen in fungi and yeasts, and that of Berthelot[5] on arabinose.

General chemistry of plants.—The contributions to this subject have been neither numerous nor important. Among the more important might be mentioned the recent investigations of Berthelot and André[6] relating to the decomposition of sugars under the influence of acids, and especially upon the production of carbonic acid; and that of Delepine[7] on the action of water on formic aldehyde, this substance being considered one of the stages in the assimilation of carbon.

E. Fleurent[8] has established the analogies and the differences between the albuminoid products of animals and of plants. Gerber[9] has studied the chemical phenomena of the maturing of fruits, especially the gas exchanges between the acid fleshy fruits and the atmosphere during processes of maturity. Péré[10] has investigated the combustion of ternary organic bodies.

Analytical chemistry.—In this class of investigations the determination of nitrogen is of especial interest. Pagnoul[11] has made a study of the distribution of nitric nitrogen and ammoniacal nitrogen in the different plant organs. Nitric nitrogen diminishes as one advances toward the upper organs, while the total nitrogen increases.

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[1] Bul. Soc. Bot. France, ser. 3, 3 (1896), p. 124.

[2] Compt. Rend., 122 (1896), p. 91.

[3] Rev. gén. Bot., 8 (1896), p. 5 (E. S. R., 7, p. 837).

[4] Bul. Soc. Bot. France, ser. 3, 3 (1896), p. 236.

[5] Compt. Rend., 123 (1896), p. 625.

[6] Compt. Rend., 123 (1896), p. 567; Moniteur Quesneville, 12 (1896), p. 907.

[7] Ibid., p. 120.

[8] Paris: Gauthier-Villars, 1896.

[9] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 178.

[10] Ann. Inst. Pasteur, 10 (1896), p. 418.

[11] Ann. Agron., 22 (1896), pp. 540, 543.

A. Berg and C. Gerber[1] have given a method for the investigation of organic acids in plants, based upon the action of sulphuric acid upon citric acid and on the solubility of ammonium malate in alcohol, and have investigated oxalic, citric, and malic acids. Lindet,[2] by means of the variable solubility of the salts of quinin and cinchonin in methyl alcohol, has been able to identify and separate the principal acids contained in plants.

Rivière[3] has criticised the Kjeldahl method and offered some suggestions for its perfection.

C. Girard[4] has made a chemical study of the value of leaves for forag , it being a continuation of his previous work on the chemical composition of twigs used for forage. The chemical analyses indicated that the leaves were more nutritious than the twigs, comparing with alfalfa hay in nutritive value, pound for pound of dry matter.

Attention is called to a manual of analytical chemistry by Trubert.[5] It seeks to popularize the analysis of soils, fertilizers, water, milk, etc.

PLANT PATHOLOGY.

As a work of general application on plant pathology, we may mention that of Prillieux[6] on the diseases of agricultural plants and fruit and forest trees, in which the author gives practical remedies for combating parasitic diseases. Mangin,[7] in an article on the treatment of parasitic diseases of plants, gives a brief résumé of the effect of external conditions and preventive measures on parasites. The same author[8] calls attention to the action of light on the development of parasitic diseases and shows the value of β-naphthol and its salts for combating the parasites of the grapevine.

Quinta[9] has revived the old idea of grafting for preventing certain diseases, and calls attention especially to the prevention of diseases of the chestnut by grafting it upon the oak. Molliard[10] has shown the effect of plant and animal parasites in causing malformations of floral organs. The same author[11] has published a review of the works on plant pathology, published in France and other countries in recent years.

Ravaz and Gouirand[12] have studied the action of certain chemicals

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[1] Rev. gén. Bot., 8 (1896), p. 295; Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 156.

[2] Compt. Rend., 122 (1896), p. 1135; Moniteur Quesneville, 12 (1896), p. 556.

[3] Jour. Agr. Prat., 1 (1896), p. 981.

[4] Ann. Agron., 22 (1896), p. 375.

[5] Congres Soc. Savants. Sec. chimie, 1896, p. 12.

[6] Paris: Firmin-Didot, 1896.

[7] Jour. Agr. Prat., 1 (1896), p. 746.

[8] Bul. Soc. Nat. Agr., 1896, p. 308.

[9] Ibid., p. 194.

[10] Ann. sci. nat. Bot., ser. 8, 1 (1895), p. 67.

[11] Rev. gén. Bot., 7 (1895), p. 465.

[12] Compt. Rend., 123 (1896), p. 1086.

upon the germination of the spores of the black rot of grapes. As a result of more than 4,000 experiments they found that acidity of the culture medium favors germination of the spores, while an alkalinity equivalent to 0.0001 sulphuric acid was able to completely prevent it. On this account the immediate effect of alkaline solutions of fungicides will be much greater than that of acid solutions. Copper was found much less efficient against black rot than against mildew, and zinc had about the same action as copper. Mixtures of copper and zinc gave no better results than either used alone. Sulphur is without effect when used alone, and may reduce the efficiency of copper solutions when used in combination with them.

Lavergne,[1] who was commissioned by the Minister of Agriculture to study the black rot in several of the vine-growing provinces, has made an interesting report upon the subject. According to Marre,[2] who has investigated the preventive treatment of this disease, the efficiency of copper solutions is clearly demonstrated; but to be successful the applications must be made frequently, beginning very soon after the commencement of growth. Verdigris (acetate of copper) was the most efficient fungicide, and should be used in 1 per cent solutions. The experiments showed the good effect and profitableness of the treatment. Lavergne and Marre[3] have published a practical manual on the treatment of black rot. This disease, which next to phylloxera is one of the most destructive to grapes, has also been investigated by Prunet,[4] of the University of Toulouse. He has demonstrated that the fungus passes the winter in the form of sclerotia, the destruction of which thus becomes very important. Consequently burning all mummified grapes is advised.

Viala and Ravaz[5] have studied the browning of grape cuttings, and Tachoues[6] the brown rust of the grape and its treatment. J. d'Arbaumont[7] has reported a curious development of a grapevine. A graft upon a riparia stock sent out 3 branches the first year, 2 of which produced normal fruit, while the other aborted some of its flowers. The flowers were usually chloranthic in some of their organs, and the ovaries were extremely prolific. This variation has been fixed by cuttings and layers.

Roze[8] has published numerous notes on potato scab. He has found bacteria producing the disease in different varieties of potatoes, the species of bacteria being named *Micrococcus imperatoris*, *M. albidus*, and *M. flavidus*.[9] In a subsequent article[10] the author suggests that

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[1] Bul. Min. Agr. France, 15 (1896), p. 285.
[2] Ibid., p. 133.
[3] Paris: Masson, 1896.
[4] Compt. Rend., 122 (1896), p. 739.
[5] Ibid., p. 1142.
[6] Bul. Agr. Alger. et Tunis, 1896, p. 515.
[7] Bul. Soc. Bot. France, ser. 3, 3 (1896), p. 281.
[8] Bul. Soc. Nat. Agr., 1896, No. 5.
[9] Compt. Rend., 122 (1896), pp. 543, 750.
[10] Compt. Rend., 123 (1896), pp. 613, 759.

Bacillus subtilis is associated with *Micrococcus albidus*. In another memoir[1] he reviews the investigations of Thaxer and Bolley on the cause of potato scab and maintains that the disease is due to *Micrococcus pellucidus*, which prepares the way for other fungi. The writer believes that this question is by no means definitely settled.

Investigations into the causes of the yellowing of beet leaves, a disease imperfectly understood, have been begun by Troude,[2] and Prillieux[3] has studied the penetration of the roots of alfalfa and beets by *Rhizoctonia violacea*, and has investigated the various anatomical relations of the parasite and the host plant. Grosjean[4] has recommended Paris green as a means for combating the beet Silpha.

P. Vuillemin[5] has demonstrated that leprosy of beets is due to *Cladochytrium pulposum* or *Physoderma pulposum*, a widely spread parasite of various chenopodaceous plants. The swellings caused by the organism attain considerable size, a part of the reserve material of the beets being diverted from its normal use. The destruction of all wild chenopods about the beet field is recommended. A disease of beans caused by *Tylenchus devastatrix* has been reported by Debray.[6] This nematode is found to attack the stem, leaves, and fruit, causing the flowers to fall, and destroying the crop. The whole plant often succumbs to its attack. Severin[7] has reported on means for the destruction of two troublesome insects of the common osier (*Salix viminalis*). Valery-Mayet[8] has reported means for preventing attacks on plums by *Scolytus pruni*, *Rhynchites bacchus*, and the larvæ of *Phalœna brumata*. Grosjean,[9] who has been studying the cherry Chematobia, recommends the means adopted in the United States for its repression.

P. Vuillemin[10] has reported on a disease of larch and pine trees, and has established a new family of fungi, Hypostomaceæ, which has affinities with the Ascomycetes. Of the 2 species reported, *Meria laricis* is parasitic on larch, and *Hypostomum flichianum* attacks and may destroy *Pinus austriaca* and *P. montana*. Crie[11] has reported on a critical study of the parasitic diseases of the apple. J. Kunckel[12] has studied the biological problems relative to the injury done maize, sorghum, and sugar cane by the larvæ of *Sesamia nonagrioides*. He recommends the destruction of all stubble before winter, and of all other seriously diseased host plants in or about the field.

[Concluded in next number.]

[1] Compt. Rend., 122 (1896), p. 1012.
[2] Jour. Agr., 2 (1896), p. 578.
[3] Bul. Soc. Bot. France, ser. 3, 3 (1896), p. 9.
[4] Bul. Min. Agr. France, 15 (1896), p. 346.
[5] Compt. Rend., 123 (1896), p. 758.
[6] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 174.
[7] Jour. Agr. Prat., 2 (1896), p. 357.
[8] Bul. Min. Agr. France, 15 (1896), p. 160.
[9] Ibid., p. 348.
[10] Compt. Rend., 122 (1896), p. 545 (E. S. R., 7, p. 835).
[11] Bul. Min. Agr. France, 15 (1896), p. 610.
[12] Compt. Rend., 123 (1896), p. 842.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The quantitative separation of wheat proteids, G. L. TELLER (*Arkansas Sta. Bul. 42, pp. 81–104*).—The author reports a series of noteworthy investigations to devise a method for the quantitative separation of the proteids in wheat, especially for determining the gluten. The work is based largely upon the characteristics of wheat proteids as described by Osborne and Voorhees.[1]

The author started out with the proposition that "all non-gluten nitrogen will be dissolved from wheat meal by thoroughly extracting with 10 per cent salt solution and that the gluten nitrogen will remain undissolved;" but his investigations showed that a 1 per cent salt solution is preferable to a 10 per cent solution for this separation, and that this salt solution dissolved a small amount of gliadin (one of the gluten proteids), making it necessary to correct the result for non-gluten nitrogen by subtracting 0.27 per cent. It is shown that "the so-called true gluten obtained by mechanical washing away of the starch and computing the remaining proteids from the nitrogen content of the crude gluten obtained gives results which are much too low when compared with the sum of the gliadin and glutenin." The explanation offered is that "an indefinite amount of gliadin is dissolved and washed away. In view of this fact, the mechanical method of determining gluten in wheat and flour is even more unsatisfactory than has formerly been thought."

The investigations made in determining non-gluten nitrogen, gliadin, proteose, edestin and leucosin, and amids are described and tables given showing the nitrogen in different compounds soluble in 1 per cent sodium chlorid solution.

From his investigations on proteose the author believes that "the proteose and proteose-like body found by Osborne are really the alcohol soluble proteids (gliadin), small quantities of which have been carried into solution and exhibit their characteristics unchanged. Furthermore, these alcohol-soluble proteids possess certain properties which have been thought to be characteristic of proteoses."

The "official method" for the determination of albuminoid nitrogen (with cupric hydrate and alumina) was found deficient for wheat, and

[1] Connecticut State Sta. Rpt. 1893 (E. S. R., 5, p. 1079).

the use of phospho-wolframic acid as a precipitant for the albuminoids is preferred.

The author suggests the following methods for the quantitative determination of wheat proteids:

"*Total nitrogen.*—The Gunning modification of the Kjeldahl method has been used throughout this work. More concordant results have been obtained with 1 gm. of material than with 2 gm.

"*Non-gluten nitrogen.*—Put 5 gm. of the material to be examined into a 250 cc. measuring flask. Add about 15 cc. of a 1 per cent solution of sodium chlorid and shake thoroughly. To the resulting homogeneous mass add enough of the same solution to fill the flask nearly to the neck. Shake the contents of the flask at intervals of 10 minutes during 1 hour. Fill to the mark with salt solution, mix thoroughly, and let stand for 2 hours. Decant the liquid onto a 12½ cm. dry filter of good quality, leaving the greater bulk of the solid material in the flask. The filtrate will be clouded, but if refiltered through the same filter into a clean flask it will generally be perfectly clear. Determine the nitrogen in 50 cc. of this extract. From the percentage of nitrogen thus obtained subtract 0.27 per cent as corresponding to the nitrogen obtained from the gliadin soluble in 1 per cent salt solution under the conditions prescribed above. The remaining percentage of nitrogen is that corresponding to the non-gluten nitrogen in the sample examined.

"*Gluten nitrogen.*—This is the difference between total nitrogen and the non-gluten nitrogen as obtained above. The gluten nitrogen may also be found by subtracting the sum of the edestin, leucosin, and amid nitrogen from the percentage of total nitrogen.

"*Edestin and leucosin nitrogen.*—To 50 cc. of the clear salt extract, obtained as described above, add, in a Kjeldahl digestion flask of 500 cc. capacity, 250 cc. of pure 94 per cent alcohol (188 per cent proof, redistilled). Mix thoroughly and allow to stand over night. Collect the precipitate on a filter (10 cm.) of good quality, return to the flask, and determine the nitrogen, making proper correction for the nitrogen in the filter.

"If desired, these two proteids may be separated by coagulating the leucosin at 60° C. and precipitating the edestin by adding alcohol to 50 cc. of the clear filtrate as before. The nitrogen in each precipitate may then be determined.

"*Amid nitrogen.*—Precipitate all proteids from 100 cc. of the clear salt extract obtained as above by adding 10 cc. of a 10 per cent solution of phospho-wolframic acid, made by dissolving the pure solid in distilled water. Allow to settle before filtering and determine the nitrogen in the clear filtrate. . . .

"[After] adding 20 cc. of concentrated sulphuric acid the water can be readily boiled off, especially if the flask be protected from the naked flame with a thin sheet of asbestus. When the acid ceases to foam it is cooled slightly, sulphate of potash added, and the nitrogen determination completed in the usual way. After adding the sulphate the time required for the digestion is but a few minutes. . .

"The difference between the nitrogen found and the total nitrogen of the sample gives the amount of albuminoid nitrogen with equal accuracy [to that separated by means of cupric hydrate]. . . .

"In case of bran, and perhaps immature or sprouted wheat, it may be necessary to add a somewhat larger quantity of the [phospho-wolframic] acid solution to produce complete precipitation of the proteids. In such cases the filtrate should be tested by the addition of a few cubic centimeters of the acid.

"*Gliadin nitrogen.*—Extract 1 gm. of the material with hot 75 per cent alcohol. [The material with 100 cc. of the alcohol is heated on a water bath just below the boiling point of the alcohol, being frequently shaken during the first hour and allowed to remain quiet during the succeeding hour, after which the hot solution is decanted through a filter, 25 cc. of hot alcohol added to the residue, heated on the bath for 10 minutes, and filtered. The latter operation is repeated six times. The

nitrogen is determined in the residue (free from alcohol) by the Kjeldahl method, deducting the nitrogen of the filter paper; or in the filtrate, first distilling off the alcohol and evaporating the solution to dryness.]

"From the percentage of nitrogen dissolved by the alcohol subtract the percentage of amid nitrogen. The difference will be the gliadin nitrogen.

"*Glutenin nitrogen.*—The difference between the gluten nitrogen and the gliadin nitrogen gives the glutenin nitrogen.

"*Proteids.*—The amount of the various proteids may be found by multiplying the percentage of the corresponding nitrogen obtained by 5.7. This factor is deduced from the average nitrogen contents of the proteids of wheat as found in a large number of analyses made by Osborne and Voorhees. It undoubtedly approximates much nearer the truth than the factor 6.25.

"Wheat for the above work should be ground so that the endosperm shall pass through a sieve having circular holes of ½ mm. in diameter. The bran of the grain, being in thin flakes, will be sufficiently fine if made to pass through a sieve with circular holes 1 mm. in diameter and the work of pulverizing will be greatly lessened."

In conclusion, the author gives the results of the separation of the proteids of a number of samples of spring and winter wheat and of wheat flour and other mill products.

"It has been frequently stated that bran contains no gluten. In the analysis of the sample of bran shown in the table both gluten proteids [gliadin and glutenin] are shown to be present in considerable quantity. A portion of this gliadin is from adhering endosperm. However, the pure sifted dust, which consists of the outermost portion of the grain, contains a small amount of gliadin. The explanation of the formation of gluten by Dr. Osborne indicates that the presence of the gluten proteids in bran and the nonformation of gluten in the usual mechanical method of separation are perfectly consistent. The true explanation seems to be that the woody fiber of the bran prevents the uniting of the gluten particles into the gluten mass characteristic of flour and wheat meal.

"The variation of the nitrogen compounds among different mill products from the same mill are interesting. Among these the gradual increase of amids, of edestin and leucosin, and of glutenin from the finest flour to the bran and the corresponding gradual decrease of gliadin are worthy of note. . . .

"As between the patent flours from winter and from spring wheat the equal amounts of gliadin and the great difference in the amounts of glutenin are suggestive. There may also be a hidden meaning in the very low proportion of gliadin found in the two samples of white wheat examined. A knowledge concerning this and other matters relating to this subject may give information which will be useful in the blending of wheats and flours to improve the quality of the latter. This is now practiced to some extent by bakers and millers upon their knowledge of the general physical characters of the material, and it is believed by many to be attended with good results."

A proteose of wheat, T. B. OSBORNE (*Amer. Chem. Jour.*, *19* (*1897*), *No. 3*, *pp. 236*, *237*).—In this note the author refers to the suggestion made by G. L. Teller (see above) that the proteose and proteose-like body separated from wheat by Osborne and Voorhees was gliadin. Osborne replies that Teller has erroneously assumed gliadin to be wholly insoluble in 1 to 10 per cent salt solutions and that proteoses of wheat are completely precipitated by adding alcohol to 75 per cent. He explains Teller's results on this basis and also by the fact that "we separated the proteids from our extract by saturating with ammonium

sulphate, a process which rendered the gliadin insoluble in the strong solution in which the proteids were subsequently redissolved. . . . The proteose which we described we separated as such from the extracts, and could, therefore, by no possibility have mistaken gliadin for it."

Preparation of soluble starch and starch solution, O. FOERSTER (*Chem. Ztg., 21 (1897), No. 6, p. 41*).—*Soluble starch.*—In a deep porcelain dish heat to boiling 200 to 300 cc. of water to which has been added 5 cc. of hydrochloric acid (sp. gr. 1.124). Remove from the flame and add gradually, with stirring, 20 to 25 gm. of starch made into a uniform paste with a little water, continuing until the liquid becomes of uniform consistency and tolerably thin. Now heat, with constant stirring, until the solution becomes as thin as water and clear. Cool and filter, precipitate with alcohol, and wash the precipitate with alcohol until free from chlorin, and finally with ether; then dry, first in the air and afterwards with gentle heat, or, better, over sulphuric acid.

Starch solution.—Dissolve 20 gm. of starch in the manner above described, with this difference, that the hydrochloric acid is accurately measured out and its acid content accurately determined with a view to subsequent neutralization. The accurately neutralized solution of starch is filtered and made to 1 liter with glycerin.

To both of these preparations, the soluble starch as well as the solution in glycerin, iodin imparts a faultless blue.—J. T. ANDERSON.

A new method for the quantitative determination of crude fiber, LEBBIN (*Arch. Hyg., 28 (1897), No. 3, pp. 213–243*).—The author enumerates over 30 methods which have been proposed for determining crude fiber, and describes experiments by himself to devise an improved method, especially for grains and materials rich in carbohydrates. He tried a long list of reagents, including water, potash solution, Schulze's reagent, bisulphite solution, pepsin-hydrochloric acid, and peroxid of hydrogen, and gives the results with each. He finally settled upon peroxid of hydrogen, using a solution containing about 20 per cent of H_2O_2. Alone this had very little action on gelatinized starch, but when a little ammonia was added the starch was rapidly dissolved to a clear solution, oxygen and carbon dioxid being given off. Potato starch was completely dissolved, but with starch from corn, rice, and wheat small residues of intercellular tissue remained undissolved, and in the case of wheat starch the hairs of the kernel were also found in the residue. This latter point is said to furnish a convenient means of distinguishing between wheat flour and rice flour.

Filter paper treated with the reagent showed losses ranging from 2.725 to 5.65 per cent, and a sample treated a second time showed a loss of 1.46 per cent. The same paper lost 9.75 per cent by the Lange method and 14.62 per cent by the glycerin-alkali method. Cotton wadding showed a loss of 13.41 per cent by the new method and 12.475 per cent by the Weende method; a finer quality lost 2.33 per cent by the new method and 2.225 per cent by the Weende method; and "wood-

wool cotton" lost 16.87 per cent by the new method and 16.64 per cent by the Weende method.

The conclusion is reached that the new reagent does not attack the cellulose of these materials, but it is quite as capable of dissolving their impurities as the Weende method, which is the more energetic in its action.[1]

Gluten prepared from wheat flour, the commercial preparation of gluten (aleuronat), and nuclein (in wheat bran) were all dissolved by treatment with peroxid of hydrogen and ammonia. It is assumed that the other constituents—coloring matters, organic acids, tannins, alkaloids, and fat—are removed by this treatment.

The method as finally elaborated is described as follows: Three to five grams of flour or bran is passed through a 0.2 mm. sieve, intimately mixed with 100 cc. of water in a beaker, and boiled a half hour to gelatinize the starch. To this is added 50 cc. of a 20 per cent solution of peroxid of hydrogen, and the whole boiled for 20 minutes, 15 cc. of 5 per cent ammonia being added in 1 cc. portions during the boiling. It is then boiled 20 minutes longer, and filtered while still hot through a weighed filter, washed with hot water, dried, and weighed. The ash is deducted from the residue, and in case of materials very rich in protein this also is deducted. The solutions are said to filter readily, which is quite an advantage.

Comparisons on rye bran showed 37.10 per cent of crude fiber by the new method, and only 9.78 per cent by the Weende method; and on "black flour" (similar to bran), 12.63, 12.85, 12.55, and 12.93 per cent by the new method, and 3.69 and 3.645 per cent by the Weende method. As a rule, the parallels by the new method agree fairly well. Thus, a sample of rye bran gave 14.11 and 14.28, 12.96 and 13.37, 14.19 and 14.34 per cent; wheat bran, 19.83 and 19.80; wheat kernel, 5.36 and 5.72 per cent. "The results obtained are sufficiently constant." Slight changes in the strength of the peroxid of hydrogen solution are said to be of no importance.

A modification of Stutzer's method for the determination of albuminoid nitrogen in substances rich in starch, H. TRYLLER (*Chem. Ztg., 21 (1897), No. 8, p. 54*).—The determination of albuminoid nitrogen in substances containing much starch by Stutzer's method is both tedious and liable to inaccuracy, owing to the difficulty of thoroughly washing the precipitate made by the copper hydrate. The author proposes to dissolve the greater part of the starch by means of diastase to facilitate the filtration.

He reports experiments with a variety of substances, using the following method of comparison: For 1 gm. samples of each substance were weighed out in beakers, 100 cc. water added, and the mass stirred until it became of uniform consistency. The beakers were heated for

[1] Suringar and Tollens have recently shown (E. S. R., 8, p. 741) that the reagents of the Weende method change and dissolve the true cellulose.—ED.

10 minutes in boiling water until the starch gelatinized. They were then divided into 2 groups, 2 samples of each substance to be treated without and 2 with diastase. To each of the former 2 cc. of the alum solution and then the copper hydrate (0.3 gm. CuO) were added, heated again for 10 minutes, and allowed to cool. The other set was cooled to 65°, 10 cc. of the malt extract (100 gm. malt with 500 cc. of water) added, kept for 20 minutes at 65°, then after the addition of the alum and copper hydrate as in the other, heated again in boiling water for 10 minutes.

For filtering, the author prefers the folded filter 15 cm. in diameter. In some cases mercury was used in the Kjeldahl digestion and then in the distillation flask enough sodium sulphid was added to precipitate both mercury and copper. But in most cases no mercury was used and the oxidation was completed by using potassium permanganate at the conclusion of the digestion.

Corrections must be made for the nitrogen contained in the malt extract and in the filter paper. These were determined by making blank determinations, using the same amount of reagents as were used in the other experiments.

The results of these determinations show that the diastase does not so alter any part of the albuminoid substances as to prevent their precipitation by the copper hydrate. The amount of albuminoid nitrogen found with and without the use of malt agreed very closely.

In the practical carrying out of the analysis it is recommended that the diastase be added after the copper hydrate. This process differs, therefore, from Stutzer's in that after the liquid has cooled down to 65° 10 cc. of the malt extract is added and the whole kept at 65° for 20 minutes, or is simply allowed to cool.—J. T. ANDERSON.

The quantitative determination of perchlorate in saltpeter, F. WINTELER (*Chem. Ztg., 21 (1897), No. 10, pp. 75, 76*).—The author points out that the method recently proposed by Erck (see below) involves an appreciable loss of chlorin as perchlorate and that where only a little perchlorate is present it may not be detected by the method. He proposes another which is said to be free from that objection and otherwise reliable. It depends on the fact that fuming nitric acid at a temperature above 200° C. is capable of reducing the perchlorate to the chlorid. The chlorate is also reduced, but can readily be removed from a mixture with the perchlorate by evaporation with concentrated hydrochloric acid. In experiments which he reports the author used a pure potassium perchlorate. A given quantity of material in the solid form is placed in a strong glass tube, capable of resisting both heat and pressure, silver nitrate is added in excess to precipitate the chlorin from the chlorid which results from the reducing process, the required amount of fuming nitric acid is poured in, and the tube is hermetically sealed. After exposing the tube and its contents to the required temperature for 5 hours, the resulting silver

chlorid is collected and weighed. The actual and the theoretical amounts of silver chlorid agree very closely.

For the determination of the perchlorate in saltpeter about 10 gm. is used. If a chlorate is to be analyzed, it is treated in the same way except that it is put in a smaller tube to avoid premature contact with the acid.—J. T. ANDERSON.

Recognition of perchlorate in saltpeter, ERCK (*Chem. Ztg., 21* (*1897*), *No. 1, p. 10*).—Dissolve 100 gm. of saltpeter in 80 cc. of water, add 7 cc. of nitric acid (sp. gr. 1.4), warm, and then add 8 cc. of alcohol (92° Tr.) and boil about 5 minutes. This treatment drives off all the chlorin which may be present in the form of chlorid and chlorate, and testing with silver nitrate shows no reaction. Saturate with sodium carbonate, wash the contents into a platinum dish, evaporate to dryness and ignite. Take up the residue with warm water and test for chlorin with silver nitrate. The presence of chlorin indicates that the perchlorate existed in the saltpeter under examination.—J. T. ANDERSON.

The mechanical analysis of basic phosphatic slags, H. W. WILEY (*Jour. Amer. Chem. Soc., 19* (*1897*), *No. 1, pp. 19–22, pls. 2*).—The action of a solution of ammonium citrate on basic phosphatic slag is different with different samples. Some samples are found to contain larger proportions of particles of siliceous slags, iron, and steel than others. This makes a mechanical analysis desirable as a preliminary to the determination of the available phosphoric acid. The author describes a tentative method for the mechanical analysis of phosphatic slags, by which the coarser portions are separated by means of sieves of bolting cloth and the finer portions by subsidence in alcohol. It was found that the finest portions contained the highest percentages of both total and available phosphoric acid. The range for total phosphoric acid was from 13.91 per cent to 18.21 per cent and for available phosphoric acid from 6.24 per cent to 14.91 per cent.—F. W. MORSE.

Critical studies of the volumetric analysis of the caustic alkalies and alkaline carbonates and the use of phenolphthalein and methyl orange as indicators, F. W. KÜSTER (*Ztschr. anorgan. Chem., 13* (*1896*), *No. 2–3, pp. 127–150*).—An exhaustive investigation of the various volumetric methods for analyzing mixtures of caustic alkalies and alkaline carbonates and the behavior of methyl orange and phenolphthalein under such conditions.

C. Winkler's method is shown to be the only correct process for accurately determining the amount of alkaline hydroxid present in a mixture containing carbonate. The total alkali can be accurately estimated by titration with methyl orange as the indicator.

The color of methyl orange is strongly affected by carbon dioxid. It is therefore necessary in titrating solutions of alkali which contain carbonates to always stop at a certain normal tint, which is defined by comparison with an equally concentrated water solution of the color saturated with carbonic acid.

Phenolphthalein is colored by alkaline bicarbonates in dilute water solutions. The color is weakened by carbon dioxid and disappears completely in the presence of large quantities. The indicator is therefore useless for the accurate titration of alkali solutions which contain carbonates.—F. W. MORSE.

Recovery of waste platinum chlorid, H. W. WILEY (*Jour. Amer. Chem. Soc., 19 (1897), No. 3, pp. 258–261*).—Waste platinum from potash determinations is collected and to the hot water solution of the potassium-platinum chlorid is added aluminum in the form of clippings or turnings. Reduction soon goes on vigorously. It is advisable to add a little hydrochloric acid to promote the settling of the reduced platinum. When reduction is complete, the excess of aluminum is dissolved in hydrochloric acid. The spongy platinum is then filtered and washed by decantation, and next treated with strong nitric acid because aluminum often contains a little copper. After filtering and washing free of acid, the platinum is dissolved in aqua regia and the platinum chlorid prepared by the usual evaporation and purification from nitric acid.—F. W. MORSE.

Concerning properties belonging to the alcohol-soluble proteid of wheat and of certain other cereal grains, G. L. TELLER (*Amer. Chem. Jour., 19 (1897), No. 1, pp. 59–69*).—This paper gives in more detail a part of the investigation on the quantitative separation of the proteids of wheat, noticed above (p. 854).

A new method for the determination of the specific gravity of liquids, R. ZALOZIECKI (*Ztschr. angew. Chem., 1896, No. 18, pp. 552–556, fig. 1*).

Estimation of boric acid in foods, L. DE KONINGH (*Jour. Amer. Chem. Soc., 19 (1897), No. 1, pp. 55, 56*).

Volumetric estimation of phosphoric acid, B. W. KILGORE and C. B. WILLIAMS (*North Carolina Sta. Rpt. 1895, pp. 259–280*).—A reprint of Bulletin 119 of the station (E. S. R., 7, pp. 741, 742).

Method for the determination of carbonic acid by means of iodin, J. K. PHELPS (*Ztschr. anorgan. Chem., 12 (1896), No. 6, pp. 431–435*).

The determination of casein in human milk, G. MERCIER (*Répert. Pharm., 1897, p. 49; abs. in Chem. Ztg., 21 (1897), No. 17, Repert., p. 45*).—A discussion of the method.

The determination of solid fats in compound lards, G. F. TENNILLE (*Jour. Amer. Chem. Soc., 19 (1897), No. 1, pp. 51–54*).—The author shows the unreliability of the mechanical process for separating solid and liquid fats described by J. H. Wainwright.[1]—F. W. MORSE.

On the determination of stearic acid in fats, O. HEHNER and C. A. MITCHELL (*Jour. Amer. Chem. Soc., 19 (1897), No. 1, pp. 32–51, fig. 1*).—The method described is the same as that given by the authors in a previous paper.[2]

A modification of Stutzer's process of determining albuminoid nitrogen in starchy substances, H. TRYLLER (*Brewers' Jour., 21 (1897), No. 6, p. 260*).—A translation of this article from *Chemiker Zeitung* (see above).

The use of the ebullioscope and the influence upon the alcohol determination of solids in solution, F. FREYER (*Ztschr. angew. Chem., 1896, No. 21, pp. 654–659*).

A new automatic pipette, C. SANDER (*Chem. Ztg., 21 (1897), No. 4, pp. 24, 25, figs. 2*).—This consists of a globe, terminating in a narrow neck above and in a stopper-like arrangement below. The latter fits into a movable glass cap having an inlet tube on one side and an outlet on the opposite side. The stopper has an open-

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[1] Jour. Amer. Chem. Soc., 18 (1896), No. 3, p. 259 (E. S. R., 7, p. 649).

[2] Analyst, 21 (1896), p. 316 (E. S. R., 8, p. 666).

ing from the globe which terminates on one side, and which, by turning the cap, may be made to coincide with either the inlet or outlet. The inlet tube is connected with a reservoir containing the liquid to be measured. When full to the point of overflowing, the globe contains exactly the volume required, say 100 cc. To catch the overflow another smaller globe with an outlet fits, cap-like, around the neck of the first.

Note on an improved specific gravity bottle or pyknometer, E. R. SQUIBB (*Jour. Amer. Chem. Soc., 19 (1897), No. 2, pp. 111–114, fig. 1*).—A pyknometer, with a stem graduated in such a manner that the specific gravity of a liquid may be determined accurately at any of the temperatures of the standard unit volume.—F. W. MORSE.

A new form of pyknometer, J. C. BOOT (*Jour. Amer. Chem. Soc., 19 (1897), No. 1, pp. 61, 62, figs. 2*).—A pyknometer with double walls, the space between them being carefully exhausted. The liquid within the flask is kept more nearly at a constant temperature by this arrangement.—F. W. MORSE.

A new drying apparatus, O. REITMAIR (*Ztschr. angew. Chem., 1896, No. 20, p. 613, fig. 1*).

A new calibrated weighing flask, G. L. HEATH (*Jour. Amer. Chem. Soc., 19 (1897), No. 3, p. 198, fig. 1*).—The flask is especially adapted to weighing liquids, as, for instance, portions for titration.—F. W. MORSE.

A new flask for rapid distillation with steam under pressure, J. ZIEGLER (*Chem. Ztg., 21 (1897), No. 12, p. 97, fig. 1*).—This is a retort-like flask, the bulb having the shape of a flask, with the usual neck at the top, and a tube blown in the side, in appearance resembling the delivery tube of a retort. The steam is admitted through a tube which is fitted by means of a perforated stopper in the neck of the flask, while the distillation products are carried out through the other and larger tube in the side. The inconveniences of a small and bent delivery tube are thus avoided. It is made of thick, annealed glass, capable of resisting pressure. Steam under tension may thus be employed, and substances volatilized with difficulty under other circumstances may be rapidly distilled in this flask. It may also be used for distillation in vacuo.—J. T. ANDERSON.

A new capped bottle for hygroscopic, easily decomposed, and strongly odorous bodies (*Chem. Ztg., 21 (1897), No. 16, p. 139, fig. 1*).—This bottle has an inner ground stopper and a cap fitting over this. The inner stopper is either hollow or its upper part is cup-shaped, for containing absorbents or disinfectants. When the flask is to be used for protection against the moisture, carbon dioxid, or oxygen of the atmosphere, the stopper may be filled with calcium chlorid, concentrated sulphuric acid, caustic alkali, or such like. It is recommended for holding standard solutions, and also for malodorous substances and those whose vapors are unwholesome. As the flask will bear the temperature of boiling water if heated gradually, it may be used as a sterilizer, and by filling the stopper with some suitable sterilizing fluid the air surrounding the stopper and thus the contents of the flask may be kept sterile.—J. T. ANDERSON.

A new laboratory grinder, C. A. BUCK (*Jour. Franklin Inst., 143 (1897), No. 855, pp. 194, 195*).—This grinder was designed by M. White, mechanical engineer of the Bethlehem Iron Company, and has been used in the laboratory of that company for 3 years. It has given great satisfaction in grinding iron ores, limestones, fuels, fire clays, magnesite, sands, etc. It grinds the most refractory substances to an impalpable powder, and does it more uniformly and much more quickly than hand grinders.—J. T. ANDERSON.

The use of aluminum for condensers, T. H. NORTON (*Jour. Amer. Chem. Soc., 19 (1897), No. 2, pp. 153–155*).—Results of trials show that aluminum possesses about the same advantages over glass as tin in connection with the distillation of water. It is well adapted for the distillation of neutral organic liquids, especially low-boiling substances. It is superior to tin in lightness and conductivity and to glass in the latter property and in durability.—F. W. MORSE.

Report of the chemist, R. C. KEDZIE (*Michigan Sta. Rpt. 1895, pp. 170–172*).—The work done during the year is enumerated, without giving any results.

Changes in and additions to methods of analyses adopted at the thirteenth annual meeting of the Association of Official Agricultural Chemists, H. W. WILEY (*U. S. Dept. Agr., Division of Chemistry Cir. 2, pp. 6*).—These changes have already been noted (E. S. R., 8, p. 272).

Well waters on farm homesteads, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, pp. 221, 225*).—Analyses with reference to sanitary quality of 67 samples of water are reported.

Pharmaceutical institute and laboratory for applied chemistry of the University at Munich (*Chem. Ztg., 21 (1897), No. 15, pp. 131–134, figs. 4*).—A description, with plans, of this new building.

Tables for the quantitative estimation of the sugars, with explanatory notes, E. WEIN, translated with additions by W. FREW (*London: E. & F. N. Spon; New York: Spon & Chamberlain, 1896, pp. 128, fig. 1*).—A translation of Wein's *Zuckertabellen*, with some additions.

The methods of milk examination, P. SOMMERFELD (*Die Methoden der Milchuntersuchung für Aerzte, Chemiker, und Hygieniker. Berlin: August Hirschwald, 1896, pp. 57, figs. 7*).—This little pamphlet is intended primarily for physicians, chemists, and those who have to do with the control of milk. It gives methods for the qualitative and quantitative examination of milk, detection of adulterations and of preservatives, bacteriological examination of milk, examination of prepared milk, etc.

BOTANY.

The germination of barley with restricted moisture, T. C. DAY (*Trans. and Proc. Bot. Soc. Edinburgh, 20 (1896), III, pp. 492–501, figs. 2 dgms. 8*).—On account of the importance to brewers and others using malted grain, the author has investigated the amount of moisture required to produce the necessary changes at the usual temperature of growth. The determination of this degree of moisture is of considerable importance, since an inadequate supply prevents a satisfactory metabolism of the constituents of the endosperm; while with a too abundant quantity the internal changes are carried too far.

In the present paper the author reports upon the quantity of carbon dioxid exhaled, the dry weight of the embryo at the end of the germinative period, the ratio of the weight of carbon dioxid exhaled to the increase in the dry weight of the embryo, the amount of moisture in the endosperm and in the embryo at the end of the germinative period, and the quantity of growth as shown by the amount of carbon dioxid exhaled. In the experiment three kinds of barley were used and the degree of moisture for germination was determined by soaking in distilled water at the temperature of 57° F. for 24, 48, 72, or 96 hours.

In each experiment 100 kernels of selected grain were weighed and soaked for the desired period, changing the water several times. When the grain had soaked the desired time, the water was drawn off and the grain well washed with fresh water and all adhering moisture removed by gentle pressure in a clean cloth. A detailed description of apparatus and manipulations are given, together with diagrams showing the curves produced under the different conditions of the experiment.

The experiments show that an increase of moisture always produced a corresponding increase in the carbon dioxid exhaled. An increase in moisture was invariably followed during the first day or two by a slight reduction in the carbon dioxid exhaled, but the grain soon recovered and the increased quantity due to increased moisture asserted itself. In one experiment where the amount of moisture was increased 8.88 per cent the quantity of carbon dioxid exhaled was more than doubled.

The dry weight of the embryos at the end of the germinative period, as shown by the tables, was more than doubled when the amount of moisture was increased by soaking the seed 96 hours as compared with 24. For the larger amount of moisture the embryo increases more in weight for the same amount of carbon dioxid exhaled than it did when less moisture was present. The ratio between these factors was found by dividing the dry weight of the embryo by the weight of the carbon dioxid exhaled. It was found that the ratio increased as the quantity of moisture increased. In general the amount of moisture found in the embryo at the end of the germinative period was about double that of the endosperm, the disparity being greatest the smaller the amount of moisture employed in the experiment. The moisture determinations seem to indicate that growth could not be secured with any degree of success unless the moisture content in the embryo amounted to 63 per cent or more.

Taking the production of carbon dioxid as the measure of growth during germination, the period of greatest activity with varying quantities of moisture was generally found to be about the third or fourth day, the exact time varying somewhat with different varieties. After the point of greatest activity was reached there was a gradual fall in the amount of carbon dioxid exhaled until the end of the experiment. It was also found that the highest moisture content of the embryo coincided with the period of greatest activity in the evolution of carbon dioxid.

Effect of stem ringing on broad-leaved, deciduous trees, A. D. RICHARDSON (*Trans. and Proc. Bot. Soc. Edinburgh*, *20* (*1895*), *II*, *pp. 337–339*).—A brief report is given of some experiments conducted to ascertain the effect on broad-leaved trees which possess a well-defined heartwood, as compared with those not possessing a duramen, by the removal from their stems of a cylinder of bark along with a certain amount of underlying wood. The trees in this experiment consisted of 2 maples, 2 beeches, 2 horse-chestnuts, 2 oaks, and 2 laburnums. From one tree of each kind was removed a cylinder of bark and wood about 6 in. long, with a thickness varying with the different kinds of trees. In the maple, beech, and horse-chestnut it amounted to one-half that of the whole stem, including the bark. In the oak and laburnum it consisted only of the bark and underlying sapwood.

There was no perceptible effect on leaf production produced by the removal of the bark only, nor was there any effect produced by the

removal of both bark and wood in the case of those trees which possessed no true heartwood, namely, the maple, beech, and horse-chestnut. The oak and laburnum, from which both bark and wood were removed, fared quite differently. The oak was killed above the point where the tree was ringed, but continued to live below it. The laburnum was killed outright.

The experiments show that in those species of trees which form no true heartwood the water ascends freely through the central portion of the stem as well as through the outer portion; while with those species which possess a duramen the ascent of the water is confined to the region of the sapwood. A description of the appearance of the stems the following season is given. It is stated that in the case of the horse-chestnuts, where the bark only had been removed, a callus was formed on the cut edge of the cambium, both above and below. Where both bark and wood were removed, a callus was formed above and below, and a few shoots appeared from the lower callus. In the case of the maples, where the bark only had been removed, a callus was formed above but none below; and where both bark and wood were removed, a callus was formed over each of the cut surfaces. With the beeches from which only the bark was removed, a callus was formed on both surfaces, but principally above. Where both bark and wood were removed, a slight callus was formed below but none above. In the case of the oaks, of which two different species were used, in the one from which the bark only had been removed a callus was formed above and below. In the other, from which both bark and underlying sapwood were removed, no callus was formed, although the stem continued to live and send out shoots from its sides. The laburnum from which the bark was removed developed a slight amount of callus, the greater amount being formed above. No shoots were formed from the callus of beeches, oaks, or laburnums.

The production of inoculating materials (Nitragin) for use in agriculture, J. A. VOELCKER (*Jour. Soc. Chem. Ind., 15 (1896), No. 11, pp. 767–775, figs. 7*).—The author, in a lecture before the Society of Chemical Industry, gave an account of his visit to Germany, where he investigated the commercial manufacture of Nitragin. He also gave the results of some experiments made with these inoculating materials. The substance of the first part of his paper has already appeared.[1] In the course of his remarks photomicrographs were shown of various forms of the organisms occurring in the tubercles of different Leguminosæ. Sixteen different forms were illustrated, but it is stated that on cultivating these organisms in gelatin or other nutritive media the differences disappear and the organisms can no longer be distinguished from one another.

Plat experiments were conducted by the author at Woburn and under his supervision at two other places in England. In every case

[1] Jour. Roy. Agl. Soc. England, ser. 3, 7 (1896), II, p. 256 (E. S. R., 7, p. 906).

drought seriously interfered with the sowing and growth of the crops, and the experiments can only be considered as of a preliminary nature. Eleven different leguminous plants were experimented with at Woburn and the effect of treating the seed with Nitragin and also soil treatment were tested. The sowing, which was made in May, was followed by drought and the plants did not come to maturity at the proper time and had to be cut green. The inoculated plats in this case were as good as the others, but no better. In the case of beans and peas there was greater root development in the treated plats than on the untreated, but the tubercles were plentiful in both. With other plants the untreated plats seemed better.

An extensive series of experiments was conducted with different clovers in which no cutting was made the first year, the plats being allowed to stand for another season before any conclusions can be drawn from them. It was designed to test the effect of Nitragin on "clover sick" soil.

In one of the experiments conducted under the author's supervision the crops used were green peas, sweet peas, and 2 kinds of beans. In these experiments soil inoculation and seed inoculation were tried and compared with no treatment. Taken as a whole it was concluded that inoculation of the soil proved the most efficacious and that both it and inoculation of seed were superior to no treatment.

In the other series of experiments the effect of soil and seed inoculations on 15 different leguminous crops was tested, and in the case of 12 of them there was more root growth on the treated than on the untreated plats, while in 3 instances the untreated plats showed the greatest root growth. The 3 exceptions were kidney vetch, peas, and beans. It should be stated, however, that beans had previously been grown upon the land, and it is very probable that the organisms suited for bean and pea growth were already abundantly present. The necessity for inoculation with Nitragin derived from the same crop as that to which it is applied is not forcibly shown by the author's conclusions.

In general the author believes that the inoculation of leguminous crops produces greater root development and more tubercle formation. As between the inoculation of the seed and the soil there was no very conclusive evidence, but the balance seemed to be in favor of soil inoculation.

An interesting point to be determined is whether the greater root and tubercle development can be utilized in the subsequent crop. This and other questions are to be considered another year in a wide series of practical trials.

Report of the consulting botanist, C. F. WHEELER (*Michigan Sta. Rpt. 1895, pp. 179–185, fig. 1*).—A report is given on some of the more important weeds, including the general characteristics and distribution of the Russian thistle (*Salsola kali tragus*), bracted plantain (*Plantago aristata*), horse nettle (*Solanum carolinense*), buffalo bur (*S. rostratum*), false flax (*Camelina sativa*), and wild carrot (*Daucus carota*).

Notes are also given on corn smut, with description of the fungus, methods of infection, and suggestions for its prevention; and estimates are made as to the amount of loss occasioned. In order to ascertain the amount of smut, examinations were made in different parts of the college fields. The total number of stalks counted was 18,739, smutted stalks 4,009, and smutted ears 767, showing 21 per cent of smutted stalks, and 0.4 per cent of smutted ears.

Notes on the morphology of Melilotus officinalis, J. A. TERRAS (*Trans. and Proc. Bot. Soc. Edinburgh, 20 (1895), II, pp. 413–419*).

Contributions to the life history of Salix, C. J. CHAMBERLAIN (*Bot. Gaz., 23 (1897), No. 3, pp. 147–179, pls. 7*).

Bifaria, a new section in the genus Panicum, E. HACKEL (*Oesterr. Bot. Ztschr., 47 (1897), No. 3, pp. 73–77*).—Three new species constituting a section of Panicum are described as follows: *Panicum bifarium, P. candiculatum*, and *P. elytrochætum.*

The history of fungi, M. STAUB (*Bot. Centbl., 69 (1897), No. 9, pp. 267–271*).—The author points out the affinities of certain paleontological fungi with existing species.

Chromatin reduction and Tetrad formation in Pteridophytes, G. N. CALKINS (*Torrey Bul., 24 (1897), No. 3, pp. 101–115, pls. 2*).

New species of fungi, C. H. PECK (*Torrey Bul., 24 (1897), No. 3, pp. 137–147*).—Numerous species of fleshy fungi are described, among them a new genus, Cryptophallus.

New species of fungi, J. B. ELLIS and B. M. EVERHART (*Amer. Nat., 31 (1897), No. 364, pp. 339–343*).—The following new species of fungi are described: *Polyporus subluteus, Poria subviolacea, Flavolus striatulus, Corticium ferax, Peniophora globulifera, Asterella prosopidis, Chætomium setosum, Sordaria violacea, S. amphisphærioides, Podospora minor, Rosellina bigeloviæ, Physalospora betulinæ, Leptosphæria phaseolorum, Pleospora findens, P. oligostachyæ, Diaporthe radicina, Entypella populi*, and *Valsaria coloradensis.*

New species of fungi, J. B. ELLIS and B. M. EVERHART (*Torrey Bul., 24 (1897), No. 3, pp. 125–137*).—New species of Hymenomycetes and Discomycetes are described.

On the period of vitality in dried yeasts, H. WILL (*Ztschr. ges. Brauw., 19 (1896), No. 34, pp. 453–456; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 7, pp. 485, 486*).—Some of the ferments used in brewing and wine making are said to retain their vitality for 4 or 5 years.

On the influence of light on certain dorsiventral organs, KATHARINE C. BURNETT (*Torrey Bul., 24 (1897), No. 3, pp. 116–122, pl. 1*).

Studies on the nucleus, G. CATTERINA (*Bul. Soc. Ven. Sci. Nat., 6 (1896), No. 2, pp. 14*).

An attempt to classify common plant pigments with some observations on the meaning of color in plants, Miss M. J. NEWBIGIN (*Trans. and Proc. Bot. Soc. Edinburgh, 20 (1896), III, pp. 534–550*).

Concerning nitrogen assimilation by legumes and soil inoculation, N. VON THÜMEN (*Prometheus, 1896, Nos. 370, pp. 81–83; 371, pp. 99–102*).

Note on the discovery of symbiosis, W. T. THISELTON-DYER (*Ann. Bot., 11 (1897), No. 41, pp. 175–177*).—The discovery of symbiosis has been attributed to Schleiden, who announced the discovery of mycorrhiza on the rhizome of *Neottia nidus avis* in 1842, but it appears that an English botanist, E. Lees, announced its discovery on *Monotropa hypotitys* in December, 1841.

Composition of mold fungi, MARSCHALL (*Arch. Hyg., 28 (1896), p. 16; abs. in Bot. Centbl. Beihefte, 6 (1896), No. 7, pp. 483, 484*).—Chemical analyses were made of *Aspergillus niger, Penicillium glaucum*, and *Mucor stolonifer*, and the average composition was found to be albuminoids, 38 per cent; ether extract, 5.27; alcohol extract, 14.03; ash, 6.37; cellulose, 5.03; starch, 2.8; and water-soluble nitrogenous matter, 28.47.

Physiological wall charts, L. Errera and E. Laurent (*Planches de physiologie végétale. Brussels: Henri Lamertin, 1897*).—These charts, which are 15 in number, are 70 by 85 cm., and are printed in colors. A text of 102 pages and 86 figures accompany them. The subjects illustrated are the chemical composition of the plant and nutrition by the roots, respiration, nutrition by the leaves, transpiration, saprophytic and parasitic plants and fermentation, carnivorous plants and fixation of nitrogen by the Leguminosæ, growth of roots, etiolation, growth of stems in length and thickness, geotropism, heliotropism, twining and climbing plants, movements of leaves and flowers, and variability of species as illustrated by races of cabbage.

FERMENTATION—BACTERIOLOGY.

Practical studies in fermentation, being contributions to the life history of microörganisms, E. C. Hansen, translated by A. K. Müller (*London: Spon, 1896*).

A résumé of the uses of formalin, G. C. Freeborn (*Internat. Jour. Micros. and Nat. Sci., ser. 3, 7 (1896), No. 33, pp. 66–75*).

The bacteria which we breathe, eat, and drink, A. A. Kanthack (*Nature, 55 (1896), No. 1418, pp. 209–214*).—A lecture delivered at the London Institution.

On the preservation of potatoes for culture purposes, M. Simmonds (*Centbl. Bakt. und Par. Med., 21 (1897), No. 3, pp. 100, 101*).—After the potatoes are prepared by the usual method and cooled they are dipped 3 times in shellac, after which they are allowed to dry. They are said to keep many months in this way without any infection.

Concerning the ability of Bacillus radicicola to accommodate itself to foreign media, A. Stutzer, R. Burri, and R. Maul (*Centbl. Bakt. und Par. Allg., 2 (1896), No. 21, pp. 665–667*).

Concerning the effect of ammonium salts on microörganisms, A. Schottenfroh (*Arch. Hyg., 27 (1896), No. 3, pp. 231–248*).—Shows the poisonous properties of various salts.

Applied bacteriology, T. H. Pearmain and C. J. Moor (*London: Bailliere, Tindall & Co., 1896, pp. 390*).

A text-book of bacteriology, E. M. Crookshank (*London: H. K. Lewis, 1896, pp. XXX, 715; rev. by A. A. Kanthack in Nature, 55 (1897), No. 1423, pp. 313, 314*).—The work is rather severely criticised.

Technical mycology, I, F. Lafar (*Technische Mykologie. Jena: G. Fischer, 1897; noticed in Milch Ztg., 26 (1896), No. 7, p. 105*).—This is said to be a handbook of the physiology of fermentation for technical chemists, food chemists, agricultural chemists, pharmacists, and agriculturists.

An introduction to bacteriology, F. Hueppe (*Naturwissenschaftliche Einüfhrung in die Bakteriologie. Weisbaden: C. W. Kreidels, 1896, pp. VIII, 268, figs. 28; abs. in Bot. Centbl., 69 (1897), No. 1, pp. 13–17*).—In addition to the natural history of bacteria in general the author outlines the following classification for the genera: I, Coccaceæ, embracing the genera Micrococcus, Sarcina, and Streptococcus; II, Bacteriaceæ, including Arthrobacterium, Bacterium, and Bacillus, with Bacillus, Clostridium, and Plectridium as subgenera; III, Spirobacteriaceæ, containing Spirochæta, Vibrio, and Spirillum; IV, Leptothrichaceæ, containing the genera Leptothrix, Beggiotoa, Phragmidiothrix, and Crenothrix; and, V, Cladothrichaceæ, which is represented by the single genus Cladothrix.

A bibliography and condensed history of bacteriology conclude the work.

METEOROLOGY.

The influence of the weather on sugar-beet crops during 1891–'95, W. Rimpau (*Landw. Jahrb., 25 (1896), No. 6, pp. 935–962, fig. 1*).—This is an account of a continuation of observations begun in

1891,[1] and forms a valuable contribution to the subject of agricultural meteorology. A previous report summarized the results obtained in 1891 and 1892. The present article adds data obtained in 1893–'95, and summarizes the results during the entire period. The more recent work has been broader and more exact than the earlier, including in addition to observations on precipitation and temperature a record of observations on sunshine and soil temperatures. The more recent observations, however, have been confined to one locality, Schlanstedt, although a wide distribution of points of observation is advocated by the author. Detailed data relating to the growth and yield and quality of crop on the one hand and to meteorological conditions on the other are tabulated and fully discussed.

Observations on the crop relate to the beginning and end of planting; the beginning and end of thinning; the beginning and end of the beet-sugar making campaign, including the beginning and end of the digging of the beets for storage; the length of the period of growth; the yield and quality (percentage of sugar) of the beets; and the total production of sugar.

Precipitation was measured with a gauge placed 1.5 meters above the soil. The temperature was recorded from daily readings of exposed maximum and minimum thermometers placed 5 cm. above bare soil. Soil temperatures were determined at a depth of half a meter. Sunshine was recorded with Campbell's sunshine autograph. The results may be briefly summarized by years as follows:

1891.—The planting was delayed and therefore the period of vegetation was short. The development of the beets was very slow during the wet and cold June, which delayed the work of thinning (ended June 30). There was an insufficient amount of sunshine during the whole period of growth. An average yield was obtained, but the beets were of poor quality.

1892.—Precipitation was normal and well distributed, and as supplemented by the moisture already in the soil was sufficient. The planting was seasonable, but the development at first was rather slow, due to insufficient heat during April and May. Afterward, during June and July, the temperature was normal and the growth was more favorable. The remainder of the season was warm and the amount and distribution of sunshine was favorable to vigorous growth. Both the yield and quality of beets were excellent.

1893.—Planting was done in good season and the initial growth of the plants was rapid, but their later development was checked by insufficient rainfall. Heavy rains in October caused a reduction of the sugar content. The yield of beets, therefore, was small and the quality poor.

1894.—The results in this year are difficult to explain. The period of growth was very prolonged and the development of the beets was

[1] Landw. Jahrb., 22 (1893), p. 503.

very luxuriant during the warm, sunny, and moist July. August and September were very wet, the temperature low, and the amount of sunshine small. Nevertheless the total yield was excellent, although the quality of the beets was below medium.

1895.—The planting was somewhat delayed, but was followed by a rapid development during the moist, warm, sunny weather of May. Thinning was completed June 8. Thereafter the growth was uninterrupted and very satisfactory, due to well distributed and abundant rains, with favorable temperature and an abundance of sunshine. The yield was satisfactory and the quality of beets good.

Meteorological observations at Michigan Agricultural College, 1894, R. C. KEDZIE (*Michigan Sta. Rpt. 1895, pp. 225–251*).—Tabulated daily and monthly summaries are given of observations during 1894, in continuation of those of previous years, on hours of sunshine, sunshine and shade temperatures, atmospheric pressure, precipitation, relative humidity, wind movement, etc.

Meteorological observations (*Canada Exptl. Farms Rpt. 1895, pp. 53, 327, 367–369, 412*).—Monthly summaries of observations on temperature, precipitation, sunshine, wind movement at the Central Experimental Farm at Ottawa, Experimental Farm for Manitoba, Experimental Farm for the Northwest Territories, and Experimental Farm for British Columbia.

Determination of atmospheric ozone on Mont Blanc, M. DE THIERRY (*Compt. Rend., 124 (1897), No. 9, pp. 460–463*).

The gases of the atmosphere: The history of their discovery, W. RAMSAY (*London: Macmillan & Co., 1896, pp. 240; noted in Nature, 55 (1897), No. 1428, p. 435*).

Influence of meteorological conditions on the growth of beets in 1896, L. KUNTZE (*Ztschr. Ver. Rübenz. Ind., 1897, Feb., pp. 135–140, dgm. 1*).

WATER—SOILS.

The reduction of nitrates in cultivated soil, P. P. DEHÉRAIN (*Compt. Rend., 124 (1897), No. 6, pp. 269–273*).—The investigations on this subject, especially those of Bréal[1] and Wagner[2] on the denitrifying organisms which occur in straw and in the solid excrement of farm animals are briefly reviewed, and experiments by the author, the results of which confirm in general the conclusions of other investigators in this line, are reported.

In a solution of 200 mg. of potassium nitrate, 250 mg. of starch, and 10 mg. of potassium phosphate in 100 cc. of distilled water, to which a solution containing the denitrifying organisms was added and which was kept at 30° C., the nitrates disappeared completely in 48 hours. It was found that a considerable proportion of the nitrogen escaped in the form of protoxid. The reduction was more rapid in closed flasks than in the open air. The fact that in closed flasks the nitrogen escapes principally in the free state indicates that in this case the organisms, being deprived of the necessary oxygen from the air, were forced to appropriate that contained in the nitrates and thus accomplished their

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[1] Ann. Agron., 22 (1896), p. 32 (E. S. R., 7, p. 663).

[2] Landw. Vers. Stat., 48 (1897), p. 247 (see p. 873 of this number of the Record).

reduction. It appears, therefore, that a moderate supply of air would tend to check the reduction of nitrates under the conditions here described.

The denitrifying organisms are present in straw and manure and are probably widely distributed in the soil, but it is claimed that they seldom occur in sufficient numbers in any one place to cause any considerable reduction of nitrates. In the experiments in which such reduction was observed manure was added to the soil at the rate of about 176 tons per acre. It was found by the author that when manure was incorporated in the soil in the proportion in which it is ordinarily used in practice not only did the nitrates not disappear but they actually increased. The treatment of manure with sulphuric acid to destroy its denitrifying power is condemned by the author as expensive, harmful, and useless.

On the question of the nitrification of soils, KOCHENOVSKI (*Selvskoe Khozyaistvo ī Lyesovodstvo, 182 (1896), May, pp. 455, 456*).—In experiments in the agricultural laboratory of the Kiev University observations were made on accumulation of nitric acid and ammonia in the soil as affected by the humidity of the soil and the introduction of fertilizers.

In soils kept at a temperature of 30° R. ammonia was found to increase with the humidity of the soil, the increase being more rapid during the first week than during the second. The same was true to a less degree of nitric acid, barely perceptible amounts being formed before the end of the first week.

The experiments with fertilizers were confined to marble and potassium carbonate. The amounts of ammonia and nitric acid in 100 gm. of soil at the end of different periods are shown in the following table:

Effect of marble and potash on nitrification.

	Ammonia per 100 grams of soil.				Nitric acid per 100 grams of soil.			
	3 days.	1 week.	2 weeks.	4 weeks.	3 days.	1 week.	2 weeks.	4 weeks.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Soil fertilized with marble	0.0378	0.0498	0.064	0.064	0.0018	0.0025	0.0027	0.0030
Soil fertilized with potash	.0451	.0498	.065	.065	.0024	.0024	.0025	.0030
Soil without fertilizer	....	.0466	.055	.058	....	.0019	.0021	.0022

Thus potash as well as marble promoted the accumulation of nitrogen in the soil, but potash acted more rapidly than marble.

In field experiments on oats, carried out in connection with the above laboratory investigations, it was observed that applications of calcium carbonate were followed by greatly increased yields, while the use of potash was followed by a reduction in yield.—P. FIREMAN.

Virgin soils of Canada, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, pp. 199–205*).—Analyses with reference to fertilizing constituents of 13 samples of soil from different parts of Canada are reported. The samples are described and the results of the chemical examinations are discussed.

The chemical examination of soils and its importance in taxing land, F. WOHLTMANN (*Ztschr. landw. Ver. Rheinpreussen, 65 (1897), No. 6, pp. 45–47*).

The conservation of soil and water supply of hill countries in cultivated areas, T. J. MCKIE (*Proc. Amer. Forest. Assn., 11 (1897), pp. 137–141*).

The results of efforts at soil improvement on a large scale in the Canton of St. Gallen, E. SCHULER (*Landw. Jahrb. Schweiz, 10 (1896), pp. 47–64*).

Management of swamps, R. C. KEDZIE (*Michigan Sta. Rpt. 1895, pp. 371–376*).—A reprint of Bulletin 115 of the station (E. S. R., 6, p. 623).

The nitrifying organisms, A. STUTZER and R. HARTLEB (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 2–3, pp. 54–57*).—The behavior of the organism under various culture conditions is discussed.

FERTILIZERS.

Experiments on the preservation of barnyard manure, B. E. DIETZELL (*Landw. Vers. Stat., 48 (1897), No. 3–5, pp. 163–187*).—In these experiments samples of manure were placed in 12-liter flasks, which were closed with rubber stoppers, carrying tubes through which a current of air could be drawn. In different cases the samples were mixed with litter and with different preservatives, including gypsum, kainit, "precipitate" (containing 32 per cent water-soluble P_2O_5 and 15.5 per cent citrate-soluble P_2O_5), and double superphosphate (containing 38.5 per cent water-soluble P_2O_5 and 40.2 per cent citrate-soluble P_2O_5). Air was admitted to some of the flasks and excluded from others. The flasks were kept at a temperature ranging from 10.5 to 25° C. from July 5, 1893, to January 30, 1894. The samples of manure were weighed and analyzed at the beginning and end of the experiment, and the ammonia, passing off through the outlet tubes of the flasks, was collected in sulphuric acid and determined.

The details of the experiment are reported in full, and the results show that a mixture of solid cattle excrement and litter supplied with the proper amount of moisture and excluded from the access of air did not lose a very large amount of nitrogen or of organic matter. The loss of nitrogen from the same mixture during this period when air was admitted varied from 4.86 to 17.13 per cent of the original amount of nitrogen present; the dry matter, from 42.82 to 55.82 per cent; and the amount of ammonia produced was from 0.45 to 0.93 per cent of the nitrogen originally present in organic form. The kainit and gypsum were the most effective of the preservatives in preventing the loss of nitrogen and of organic matter.

In experiments with calf urine and litter in which the air was excluded the nitrogen of the urine was almost entirely converted into ammonia without the loss either of ammonia or of free nitrogen. In experiments in which air was admitted 16.29 per cent of the nitrogen escaped in the form of free nitrogen. This loss was almost entirely prevented by the use of preservatives. "Precipitate" and gypsum appeared to be most effective in preventing the destruction of organic matter and the loss of ammonia, although the nitrogen was almost completely converted into ammonium compounds.

In experiments in which fine soil alone or combined with carbonate of lime, "precipitate," kainit, and gypsum were used as preservatives and air admitted, nitrogen in the form of ammonia, nitrous acid, and nitric acid were not found in the samples either at the beginning or end of the experimental period except where soil, calcium carbonate, and "precipitate" were used, when a trace of nitric nitrogen was detected. None of the preservatives prevented the formation of free nitrogen to any marked extent, although gypsum was somewhat more effective in this respect than the other preservatives.

These experiments in general showed that the loss of nitrogen from both dung and litter and from urine and litter may be prevented by excluding the air. Where air had access, chemical preservatives, with the exception of "precipitate" and double superphosphate, in case of mixtures of solid excrement and litter were effective in preventing a loss of nitrogen. The production of ammonia in solid excrement is almost insignificant, while the nitrogen of urine is almost completely converted into ammonia. In view of this fact, it is suggested that it might be advisable to carefully separate the urine from the other manure and store it in receptacles from which the air is excluded.

Experiments are in progress to determine the losses from manure after it has been applied to the soil.

The fertilizing value and the preservation of nitrogen of barnyard manure, J. AEBY, R. DORSCH, F. MATZ, and P. WAGNER (*Landw. Vers. Stat., 48 (1897), Nos. 3–5, pp. 247–360, dgms. 2*).—A detailed report is given of pot experiments during several years to test the relative value of the nitrogen in commercial fertilizers and in the solid and liquid excrement of animals, as well as the influence of various preservatives upon the fertilizing value of manure. The principal conclusions of this investigation are as follows:

(1) The nitrogen of manure is decidedly less available than that of ammonium compounds and nitrates or of green plants.

(2) The nitrogen of solid excrement and of straw acts very slowly. It is transformed largely into humus, and changes very slowly into ammonia and nitric acid.

(3) The nitrogen of urine is transformed very quickly into ammonia, the transformation being complete at ordinary room temperature in 48 hours. The addition of solid excrement and straw hastens the process.

(4) The nitrogen of urine acts very quickly and its assimilability is very nearly the same as that of ammonium compounds.

(5) When a soil is liberally fertilized with fresh solid excrement and immediately seeded with quick-growing plants, the manuring may result in a reduction of yield. This reduction of yield is due to the setting free of elementary nitrogen from the nitrogenous matter which is present in the soil, or which has been applied in the more available forms of urine, green manure, ammonium compounds, or nitrates. This effect of the solid excrement is attributed to the denitrifying bacteria

which manure, especially that of horses, contains in large numbers, and was observed, not only in the fresh solid excrement, but also in the partially decomposed manure.

(6) When 100 gm. of solid horse excrement was mixed with 1 liter of water and 3 gm. of nitrate of soda and kept at an average room temperature, the nitric nitrogen was completely converted into free nitrogen in from 8 to 14 days.

(7) When a solution of nitrate was mixed with a humus soil, elementary nitrogen was very slowly set free. The same was observed when straw acted upon solutions of nitrate. The denitrifying action of the soil and straw was much greater when the two were mixed than when each was used alone. The denitrifying action of the solid excrement was decidedly increased by the addition of straw.

(8) Theoretically a well-balanced manure should contain equal amounts of nitrogen in the form of urine and in that of solid excrement and litter, but in practice manure contains as a rule 25 to 35 and even as low as 10 parts of nitrogen in urine to 100 parts in solid excrement and litter. This may be explained by the facts (*a*) that often in practice the liquid manure is drawn away from the solid manure and stored separately, and (*b*) a part of the nitrogen of the urine is lost in the form of ammonia or of free nitrogen.

(9) The objects of preservation of manure should be to check or prevent the formation of ammonia and its volatilization from the solid and liquid manure and the setting free of nitrogen by the action of bacteria. The formation of ammonia in a mixture of solid excrement and litter is so slow that it may be left out of consideration in practice, except in so far as it may affect the decomposition processes and products of the urine.

(10) When solid excrement and straw are spread in layers 2½ to 3 ft. thick they undergo very little alteration in the course of a year if the mass is packed down so as to exclude the air as perfectly as possible. If, however, the mixture is loosely spread out and frequently stirred so that the air has free access, it undergoes decomposition by which heat is generated and organic matter is converted into humus, with a loss of as much as 50 per cent of the organic matter originally present. The usual preservatives, gypsum, superphosphate-gypsum, and kainit, as well as burnt lime, used in amounts ordinarily recommended have no appreciable influence on the process of humification. During this process of humification the denitrifying power of the manure is largely reduced, but it is never entirely destroyed by this process. The effectiveness of well-rotted manure as compared with fresh manure is probably due to this reduction of the denitrifying power of the manure. The use of the usual amounts of preservatives has no appreciable effect on the denitrifying power of the manure. It was observed that on long storage and complete humification, gypsum, superphosphate-gypsum, and kainit exerted a preservative effect upon the denitrifying action of the manure, while lime produced an opposite effect.

(11) By thorough treatment of the manure with bisulphid of carbon it was possible to reduce the denitrifying power of the manure to a minimum, but on account of the amount of bisulphid needed and the time required this method of preserving manure is considered valueless for practical purposes.

(12) Sulphuric acid and copper sulphate were also found to be effective means of checking the action of the bacteria of the manure, but it still remains to be proven whether they can be employed with advantage in practice.

Contribution to the subject of the changes occurring in the decomposition of nitrogenous organic substances, T. PFEIFFER, E. FRANKE, C. GÖTZE, and H. THURMANN (*Landw. Vers. Stat., 48 (1897), No. 3–5, pp. 189–245, fig. 1*).—The experiments here recorded in detail were made on a mixture of solid cow excrement with ground peat or with cattle urine in 5-liter flasks, similar to those described by Dietzell in the article above (p. 872), or in zinc boxes capable of holding 7 or 8 kg. of the manure mixture.

In the first experiment (with a mixture of cow excrement and peat) 4 series of tests were made. In the first series no preservative was added, in the second 3 per cent of gypsum was added, in the third 3 per cent of gypsum and 1 per cent of double superphosphate, and in the fourth 3 per cent of gypsum and 1 per cent of "precipitate." Four flasks were used in each series. With 2 flasks the air was drawn over the manure and with 2 it was drawn through the manure, 1 flask in each case remaining in the experiment 5 months and 1 10 months. In one zinc box the manure was packed close and in the other it was kept loose, the experiments with these continuing for 5 months.

In the second series of experiments a mixture of liquid manure, urea solution, and ordinary or acidulated peat having about the composition of average barnyard manure was treated with from 0.3 to 1 per cent of sulphuric acid, 0.5 to 1 per cent of water-soluble phosphoric acid (double superphosphate), 0.1 to 0.3 per cent of potassium fluorid, and 0.3 to 0.6 per cent of potassium chlorid. The preservatives were applied either to the mixture or to the urea solution before mixing.

In the third series of experiments the influence of sulphuric acid and of a mixture of organic acids (butyric, capric, and caproic) either alone or combined with caustic lime or carbonate of lime upon the denitrification in samples of fresh solid horse excrement to which a nitrate solution (0.25 per cent) had been added were tested, the experiment lasting 30 days.

Other experiments are reported in which the influence of the temperature (room temperature and 30 to 32° C.) on the production of ammonia in mixtures of liquid manure, urine, and peat treated with water-soluble phosphoric acid, caustic lime, calcium carbonate, and butyric acid were tested. The influence of the exclusion of air and of a liberal supply of air upon the nitrate nitrogen in fertilizer mixtures was also studied, and comparative tests of nitrate of soda and the solid

excrement of horses, sheep, and cows treated in different ways were made on oats in pots.

The principal conclusions of these experiments may be summarized as follows:

(1) The losses of nitrogen and of organic matter in the manure were very small when only a small amount of air was admitted into the flasks. The longer and more rapidly the air was drawn through, the greater the loss of nitrogen, amounting in one case to 42.6 per cent of the nitrogen originally present. When the air was simply drawn over the manure the loss of nitrogen was still quite large, amounting to 27.6 per cent of that originally present.

(2) The action of preservatives was generally contradictory. When air was freely drawn through the flask the loss of nitrogen was not reduced by the use of preservatives to the point it reached in flasks in which no preservatives were used, but through which only a moderate amount of air was drawn.

(3) It appeared that the mechanical condition of the manure exerted a more marked effect upon its preservation than chemical preservatives. The latter can be used with advantage only when the former has been properly attended to.

(4) At a temperature of 32 to 34° C. the loss of nitrogen was considerably greater than at room temperatures.

(5) Under certain conditions the nitrogen can be converted almost entirely into the elementary form. In many of the experiments here reported the conditions were such that 42.6 per cent of the original nitrogen present was lost in this form, but the loss of ammonia, except in the case of the higher temperatures and of addition of caustic lime, was comparatively small.

(6) The setting free of the elementary nitrogen appears to be accomplished in 2 ways—by denitrification and by oxidation of the ammonia which is formed. In the experiments here reported it was accomplished almost exclusively in the second manner. Denitrification is favored by the free access of air.

(7) The addition of 2 per cent of caustic lime destroyed the denitrifying power of fresh solid horse excrement in a short time. The addition of 3 per cent of calcium carbonate and 0.5 per cent of sulphuric acid was without effect in this respect. Three per cent of caustic lime and 5 per cent of marl decidedly reduced the denitrifying power of fresh solid cow excrement in 24 hours.

(8) The transformation of the nitrogen of ammonia into free nitrogen was due in the main undoubtedly to the action of microörganisms. This oxidation was prevented by the use of a sufficient amount of superphosphate to combine with all the ammonia formed. When smaller amounts of superphosphate were employed the ammonia not fixed by the superphosphate was converted into free nitrogen. The beneficial effect of small applications of superphosphate in practice

may be explained by the fact that the conditions are not so favorable to the production of ammonia as in the experiments here reported.

(9) The almost complete prevention of the loss of nitrogen in the free state at ordinary temperatures by the addition of caustic lime and carbonate of lime is undoubtedly due to the destruction of the micro-örganisms producing this change. It may be found desirable in practice to mix caustic lime or marl with manure in order to prevent the loss of nitrogen in the free state and to insure against the volatilization of ammonia by covering the heap with earth.

(10) In these experiment ammoniacal fermentation was not checked by even the largest applications of caustic lime and superphosphate. In fact, in most cases it was promoted. It was also but slightly affected by the addition of 1 per cent of sulphuric acid.

Chemical experiments toward rendering available the phosphoric acid of mineral phosphates, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, pp. 217, 218*).—Experiments with this end in view were commenced in 1893. These showed that fusion with bisulphate of soda rendered a large proportion of the phosphoric acid of the apatite soluble.

"Since 1893 further work has been done, the details of which have not yet been published. These latter experiments comprise the following:

"(1) Heating together finely ground phosphate and sulphate of soda and treating the residue with 2 per cent citric acid solution. The results showed that phosphoric acid equivalent to 35 to 37 per cent of the phosphate had been dissolved.

"(2) Ignition of the finely ground phosphate with sodium bisulphate and treatment of the mass with 2 per cent citric acid solution. In this case 50 per cent of the apatite was found to have been rendered soluble in the acid solution.

"The by-product that was used in these experiments contained only a small proportion of bisulphate, the larger part being sulphate of soda. It did not yield, therefore, as large an amount of soluble phosphoric acid as when pure bisulphate was used."

Fertilizers (*New Jersey Stas. Rpt. 1895, pp. 13–99*).—This is practically an enlarged reprint of Bulletin 113 of the station (E. S. R., 7, p. 940), and includes the text of the State fertilizer law; notes on methods of sampling and analysis; a discussion of trade values of fertilizing ingredients, and of the valuation of fertilizers; home mixing of fertilizers; fertilizing value of natural and waste products; available phosphoric acid in ground bone; and tabulated analyses and valuations of 656 samples of fertilizing materials, including nitrate of soda, dried blood, dry-ground fish, hoof meal, ground bone and tankage, bone, boneblack, superphosphate, mineral phosphates, muriate of potash, sulphate of potash, kainit, street sweepings, saltpeter waste, snuff sand (tobacco dust), hair and wool waste, acid and wood alcohol waste, and duck grass, and home-mixed and factory-mixed fertilizers.

Natural and waste products.—"In connection with a dietary study conducted by this station in a New Brunswick household during the month of January, the total waste and refuse of the table and kitchen was collected with the idea and for the definite purpose of determining the amount of plant food contained therein. The family consisted of 1 man, 1 woman, 4 boys and 2 girls, and the wastes collected in 3 weeks

amounted to 69.71 lbs. of vegetable matter, and 26.25 lbs. of vegetable and animal (mostly animal) matter impossible to separate, a total of 95.96 lbs. The analyses of these, just as collected, and the calculated amount for one year, are as follows:

Composition of table and kitchen wastes.

	Total amount per year.	Water.	Fat.	Ash.	Organic matter.	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Vegetable	1,208.31	84.46	0.22	1.83	13.71	0.30	0.12	0.54
Animal (mostly)	455.00	58.70	13.68	9.78	31.52	1.64	2.74	.30
Whole product	1,663.31	77.42	3.90	4.00	18.58	.67	.84	.47

"[It is calculated that there could] be gathered annually from 20,000 people about 2,080 tons of garbage, with an analysis and value equal to good barnyard manure. By treating with suitable solvents and drying the residue there could be secured 388½ tons of fertilizer, worth $14.69 per ton, and over 81 tons of grease, which sells for an average of $70 per ton wherever this system is in operation. By cremation there would result 83½ tons of ashes, worth $28.53 per ton. . . .

"The total population of the cities and towns of New Jersey is approximately 918,722, and the garbage of this number of people would amount to 95,516 tons per year, from which could be manufactured 17,848 tons of tankage, worth $262,180, and 3,726 tons of grease, worth $260,800, a total of $522,980.

"Should all of this garbage be thus manipulated there would be an increase in the plant-food supply to the extent of 45 per cent of the tonnage of complete fertilizers used in this State during 1894, which could not help but diminish the cost of fertilizers to the agriculturist.

"Furthermore, there would be the direct saving of an amount of money ($5,000) more than enough to purchase, at $3.50 per unit, all of that costly constituent, ammonia, that those complete fertilizers furnished."

Available phosphoric acid in ground bone.—Determinations of the citrate solubility of phosphoric acid in 23 samples of bones (mostly steamed) and of 8 home mixtures containing bone are reported. In case of the first the degree of fineness is also given.

"These studies indicate, first, that on the average more than one-fourth of the phosphoric acid in bone is in an available form; and second, that both mechanical condition and physical structure are factors which influence availability; as a rule, the finer and softer the bone the greater the degree of availability."

Examinations were made of 2 samples of bone unmixed and mixed with sand in different proportions with the following results:

Available phosphoric acid in different mixtures of bone.

	Total phosphoric acid.	Available phosphoric acid.			
		Mixture 1 (0.5 gm. bone, 1.5 gm. sand).	Mixture 2 (1 gm. bone, 1 gm. sand).	Mixture 3 (1.5 gm. bone, 0.5 gm. sand).	Pure bone (2 gm.).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Steamed bone	26.92	13.76	13.06	12.15	10.11
Percentage of total phosphoric acid available		51.10	48.50	45.10	37.60
Button bone	25.42	10.14	8.98	7.60	6.44
Percentage of total phosphoric acid available		39.90	35.30	27.70	25.30

"Both of the samples show a high percentage of available phosphoric acid in the original bone, but it will be observed that as the amount of bone in the mixture decreases the amount of available increases. In the steamed bone it increases from 37.6 per cent when 2 gm. are used to 51.1 per cent when but ½ gm. is used. In the button bone it increases from 23.3 per cent when 2 gm. are used to 39.9 per cent when ½ gm. is used. While this does not prove that no influence on solubility is exerted by the other materials in the mixture, it does prove that the quantity of bone taken for analysis has a decided influence upon the percentage of citrate soluble that may be obtained."

Fertilizer control, H. B. BATTLE (*North Carolina Sta. Rpt. 1895, pp. IX–XVI*).—The number of brands of fertilizers sold in North Carolina in 1895 was 541, classified as follows: Simple superphosphates 105, superphosphates with potash 36, ammoniated superphosphates 330, ammoniated superphosphates without potash 11, kainit 38, miscellaneous 21. Of these 541 brands 189 were made in Virginia, 137 in North Carolina, 96 in South Carolina, 88 in Maryland, and the rest in other States, including Missouri, New York, Pennsylvania, Massachusetts, New Jersey, and Delaware. The relative amount of fertilizers manufactured in North Carolina has steadily increased since 1880. At that date only 6.38 per cent of the fertilizers used in that State was manufactured there; in 1895, 44.24 per cent.

The following table shows the average actual and guarantied composition of the principal classes of fertilizers sold in the State from 1890 to 1895, inclusive:

Composition of fertilizers on sale in North Carolina, 1890–'95.

Kind of fertilizer.	Year.	Available phosphoric acid.		Ammonia.		Potash.	
		Found.	Guarantied.	Found.	Guarantied.	Found.	Guarantied.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Acid phosphates	1890	12.92	12.25				
	1891	12.21	12.06				
	1892	12.25	12.01				
	1893	12.93	12.04				
	1894	13.73	12.00				
	1895	13.29	12.21				
Acid phosphates with potash	1890	12.04	10.90			1.77	1.42
	1891	11.17	10.29			1.66	1.50
	1892	11.22	9.97			2.06	1.53
	1893	10.38	9.60			1.78	1.40
	1894	11.27	9.77			1.77	1.47
	1895	10.78	9.32			2.02	1.93
Ammoniated superphosphates with potash	1890	9.11	8.53	2.41	2.29	2.02	1.71
	1891	8.11	8.24	2.59	2.51	2.20	1.88
	1892	8.70	8.10	2.63	2.46	2.65	2.12
	1893	8.37	8.05	2.59	2.47	2.56	1.97
	1894	9.04	8.06	2.85	2.76	2.51	2.21
	1895	8.84	7.78	3.26	3.05	2.91	2.45

The decomposition of organic matter and the humus compounds as related to the culture of the soil, E. WOLLNY (*Die Zersetzung der organischen Stoffe und die Humusbildungen mit Rücksicht auf die Bodencultur. Heidelberg: C. Winter, 1897, pp. 479, figs. 52*).—As stated in the preface, the attempt is made in this treatise to discuss in a systematic manner the results of all important investigations on the processes and products of the decomposition of organic matter with a view to enunciating the fundamental principles necessary to the rational management and use of the many

organic materials employed in agriculture. In carrying out this design it has been necessary to treat the subject not only from the chemical point of view, but also from the standpoint of bacteriology, plant physiology, and physics. For this reason the treatise will prove valuable to the hygienist, geologist, and others as well as to the tiller of the soil.

Although the work is very voluminous and exhaustive, and will appeal most strongly to the investigator or advanced student, the author has succeeded in stating fundamental facts and principles so clearly that it will prove useful to the less scientific reader.

The scope and character of the work is indicated by the following list of the subjects treated:

(1) The chemical and physiological processes involved in the decomposition of organic matter, including the chemical transformations; the rôle of the lower organisms and of animals in this decomposition; morphology, occurrence, distribution, and conditions of growth of the microörganisms to which the decomposition is due; the conditions under which the decomposition of organic matter takes place; and the character of decomposition processes as they occur in nature.

(2) The products of the decomposition of organic matter (humus compounds), including the source and nature of the humus of the soil; classification, and chemical, physical, and other properties of the various humus compounds; and the influence of humus on the fertility of soils.

(3) Artificial means of controlling the decomposition of organic matter, including the alteration of the physical and chemical properties of the soil, the handling and management of organic manures, and the preservation of feeding stuffs.

The improvement of light lands by green manuring (*New Jersey Stas. Rpt. 1895, pp. 113–116*).—This is a brief report of progress in experiments, one of which was commenced in 1893 at Allaire and the other in 1894 at Moorestown (E. S. R., 7, p. 668).

Naturally occurring fertilizers, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, pp. 206–213*).—Analyses of 17 samples of muck, 4 of mud, 1 of fern litter (bracken), and 5 of moss litter are reported, together with notes on the fertilizing value of these substances and of green manures.

On dolomitic marl, A. MAYER (*Jour. Landw., 25 (1897), No. 1, pp. 9–12*).

Night soil (*L'Engrais, 12 (1897), No. 14, pp. 325, 326*).

Green manuring, B. DYER (*Jour. Roy. Agl. Soc. England, ser. 3, 7 (1896), IV, No. 28, pp. 773–779*).

A new process for preserving barnyard manure, C. DUSSERE (*Chron. Agr. Cant. Vaud, 10 (1897), No. 2, pp. 34–37*).

Loss in weight of barnyard manure during the process of rotting, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1895, p. 42*).—Four tons (8,000 lbs.) of a mixture of equal parts of horse manure and cow manure placed on boards under a shed was turned and weighed every month for 9 months. At the end of that time the weight was reduced to 2,600 pounds.

Industrial fertilizers, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, pp. 214–219*).—Analyses of shoddy waste, tankage, slaughterhouse offal, basic phosphate of lime and potash, and ground apatite are reported, with a discussion of their fertilizing value and notes on the preparation of available phosphoric acid from mineral phosphates and the preparation and use of superphosphates.

Fertilizer analyses of the North Carolina fertilizer control, H. B. BATTLE (*North Carolina Sta. Rpt. 1895, pp. 1–25*).—A reprint of Bulletin 111 of the station (E. S. R., 7, p. 111).

Analyses of commercial fertilizers, F. W. WOLL (*Wisconsin Sta. Bul. 53, pp. 4*).—Tabulated analyses and valuations of eleven fertilizers inspected under the provisions of the State fertilizer law of 1895.

Inspection of commercial fertilizers, R. C. KEDZIE (*Michigan Sta. Rpt. 1895, pp. 325–339*).—A reprint of Bulletin 112 of the station (E. S. R., 6, p. 401).

Biology of phosphates (*L'Engrais, 12 (1897), No. 14, pp. 328, 329*).

The phosphates of L'Hérault, A. Hébert (*Ann. Agron., 23 (1897), No. 3, pp. 114–133*).

Thomas slag, L. Grandeau (*Ann. Sci. Agron., 1896, II, No. 3, pp. 410–476*).

Nile cultivation and nitrates, J. B. Fuller (*Jour. Roy. Agl. Soc. England, ser. 3, 7 (1896), IV, No. 28, pp. 617–637*).

On the injurious effect of nitrate of soda, P. Wagner (*Deut. landw. Presse, 24 (1897), Nos. 18, pp. 155, 156; 19, p. 167, figs. 2*).

FIELD CROPS.

Experiments with crimson clover to study the influence of time of seeding (*New Jersey Stas. Rpt. 1895, pp. 119–121, pls. 6*).—Crimson clover seed was sown at the station on a heavy clay loam August 4, 13, 29, and October 1, and on a farm near Moorestown, New Jersey, on a coarse sand to sandy loam July 11, 21, August 4, 18, September 14, 20, 21, 22, 29, October 4 and 23. The weather during the fall was dry and hot. Cuts are given of specimen plants of different sowings. In the coöperative test the sowings of August 4 harrowed in on pea vines turned under, and of August 18 harrowed in among late tomatoes, were most satisfactory. The experimenter states that in the latest sowings a large percentage, perhaps a majority, of the plants had stems devoid of branches.

Experiments with corn, 1896, J. F. Duggar (*Alabama College Sta. Bul. 75, pp. 361–382*).—Owing to drought the yields were light in all experiments of the year on upland soil.

Fourteen varieties were tested, and a table shows for each variety the number of pounds of thoroughly dry unshucked corn required for 56 lbs. of shelled corn, the percentage of grain in the unshucked corn, and the yield per acre of shelled corn. St. Charles (a white variety), Early Mastodon, and Blount Prolific gave the best yields—25.1, 22.7, and 22.3 bu. per acre, respectively. A table shows comparative productiveness of 39 varieties tested from 5 to 26 times in the Southern States, the leading varieties being Cocke Prolific, Mosby Prolific, Calhoun Red Cob, St. Charles, and Mammoth White Surprise. The 8 southern varieties averaged 17.2 bu. per acre and the 6 northern varieties 21 bu., and in a comparative test of seed from different latitudes both varieties used gave slightly larger returns with seed from Illinois than from southern-grown seed. The detailed results are tabulated for an experiment on ninth-acre plats to test the use of kernels from different parts of the ear as seed, and a summary is given of similar experiments at other stations.

The differences in yield were very small. Butt kernels from 4 ears produced an average yield of 2,439 grains of corn per plant, tip kernels 2,187 grains, and middle kernels 2,092 grains. The compiled results agree with those of the year's experiment at the station in placing butt kernels first, tip kernels second, and middle kernels third in productiveness.

Various distances of planting were tested, and the yields are tabulated. "In this dry season the yields were practically the same whether the distance between single plants in rows 5 ft. apart was 3 or 4 ft.; a distance of 2 feet in the row greatly reduced the yield."

On "sandy branch bottom land" 426 lbs. of crushed cotton seed per acre gave an increased yield of 3.1 lbs. over 180 lbs. of cotton-seed meal; and on land of this character which had borne 2 crops of weeds the yield was 2.8 bu. less per acre when the dead weeds were burned than when they were plowed under.

"The yield of grain was less when the entire stalks were cut and cured before pulling the ears and also less when topping was practiced than when the plants were not disturbed before gathering the ears. Financially, topping was unprofitable, and the profit in harvesting the entire stalks was doubtful where no shredder was available to prepare the stalks for feeding and when corn was valued at 45 cts. per bu., and stalks at 25 cts. per 100 lbs."

The author believes that the loss in grain caused by stripping the blades makes the process unwise unless the price of fodder is high and that of corn low; and that the labor could be more profitably employed in making hay than in pulling fodder.

Fertilizer experiments with corn on muck land, C. D. SMITH (*Michigan Sta. Rpt. 1895, pp. 116-122*).—Notes and tabulated data are given for two experiments, one at the station and the other on a farm in Van Buren County.

In the coöperative experiment 15 plats varying in size from 1 to 2 acres were used, alternate plats being left unfertilized. The fertilizers used were a complete fertilizer, calcined marl, sulphate of potash, nitrate of soda, dissolved bone, unleached ashes, and barnyard manure. At the station 8 eighth-acre plats were used, one serving as a check and the others being manured about as in the coöperative experiment. Various factors—late application of fertilizers, unfavorable distribution of rainfall, inequalities of soil, and frost injuries—operated against the perfect success of the experiments.

"In the larger experiment, where the fertilized and unfertilized plats alternated, the yield from each of the fertilized plats was greater than the average yield from the unfertilized plats upon either side of it, showing apparently that all of the fertilizers produced beneficial results. The largest yield in the series was obtained from the plat fertilized with sulphate of potash. On this plat of 2 acres, upon which was sown 500 lbs. of the above fertilizer, there was a gain of 2,776 lbs. of ears, an increase in yield of nearly one-third, over the adjoining plats. The superiority of this plat was very evident to the eye while the corn was growing and after it was cut while it stood in the shock. In the trial on the Station farm the plat receiving this fertilizer also did well as compared with the plats immediately adjoining, though some of the other plats on better soil surpassed it in yield. The ashes in the smaller experiment seem to have given better results than in the larger trial. In the latter they were somewhat coarse and lumpy and in the former perfectly dry. The barnyard manure gave poorer results than might have been expected, owing perhaps to the dry season and the lateness of application. The good results obtained in each case from the mixture of fertilizers is worth noting."

None of the fertilizers applied were financially profitable this first year, but the author considers that they were applied too late in many cases, or at too high a rate. The residual effect is to be determined by a repetition of the experiment.

Field experiments with fertilizers (*New Jersey Stas. Rpt. 1895, pp. 99, 100*).—The author summarizes the results of previous work as follows: In 9 of the 13 experiments with corn, applications of superphosphates and potash singly or in combination were followed by increased yields. Potash seemed to be particularly effective. In 2 experiments on light, sandy loams nitrogen was shown to be needed.

In experiments with oats on soils of medium fertility applications of phosphoric acid and nitrogen, especially of the former, were beneficial. These 2 elements were also the most useful in 11 experiments with wheat and rye.

With potatoes the results show benefit from both commercial fertilizers and barnyard manure. Potash, as muriate, influenced the yield most noticeably, and as sulphate it improved the quality of the tubers, with a slightly lower yield. Complete chemical fertilizers were more profitable than barnyard manure or nitrogen, phosphoric acid, or potash alone.

Grasses and forage plants of the Dakotas, T. A. WILLIAMS (*U. S. Dept. Agr., Div. of Agrostology Bul. 6, pp. 47, figs. 11*).—This bulletin includes an introductory discussion of the forage conditions in the Dakotas, with notes upon the native grasses, the irrigation problem, and conditions in the artesian basin. A list is given of the grasses and other plants of the Dakotas which are or may be of importance as forage, the plants being arranged alphabetically under their scientific and common names, and described under the common names. The grasses and forage plants collected or observed in the Dakotas in 1896 are classified by families.

Essex rape and crimson clover, H. H. HORTON (*New Jersey Stas. Rpt. 1895, pp. 121, 122*).—This is a report of a coöperative experiment conducted at Chester, New Jersey, on a sandy loam, with clayey subsoil, and in a medium state of fertility. Oats had been grown on the plat in 1892, followed by fallow in 1893 and the early part of 1894. The seed was sown June 8, after an application of 400 lbs. per acre of equal parts of ground bone and muriate of potash. In August and September the weather was very dry. The yield, calculated from 1 sq. rod, was $11\frac{1}{8}$ tons per acre. An analysis (food and fertilizer constituents) is given of the rape. The crimson clover seeded with the rape was rather an uneven catch.

Report of the agriculturist, C. D. SMITH (*Michigan Sta. Rpt. 1895, pp. 104–125*).—Notes are given on forage crops, barley, rye, and rape grown at the station; culture and varieties of millet; seeding to grass and clover; fertilizer experiments with corn on muck land (see p. 882); and crops grown for 5 years on plats without manure.

Lathyrus sylvestris has been grown with fair success at the station for several years, but it has been found by feeding tests that both sheep and cows show a decided distaste for the forage. Sheep confined upon pasture composed principally of the plant lost weight, and cows fed in the stable lost in weight and in production of milk and of butter fat when either the green or ensiled forage was fed as part of the ration.

Six varieties of wheat were selected in the fall of 1894 as most productive of the varieties grown at the station in previous years. These were planted on acre plats of "fairly uniform" soil and on smaller plats of muck soil; and were compared with Dawson Golden Chaff from Ontario, and Currell from Kansas. The Dawson Golden Chaff was grown on an 8-acre tract adjacent to the first series of plats. This variety proved most productive on both soils at the station and upon farms of nearly all of 17 coöperative experimenters reporting; but "it is almost or quite universally infected with stinking smut."

A study of a rotation for dairy farms (*New Jersey Stas. Rpt. 1895, pp. 116–118*).—Previous work in this line was reported in the Annual Report of the station for 1894 (E. S. R., 7, p. 680). The rotation consisted of (1) field corn, seeded to crimson clover in July or August; (2) crimson clover followed by fodder corn, and the land seeded to rye; (3) rye fodder, followed by oats and peas, seeded to red clover and timothy; and (4) hay.

The yields and composition (food and fertilizer constituents) of the third-year crops, grown without manure, on an acre plat are given. The amounts of food materials obtained and fertility removed are shown in the following table:

Food materials produced and fertility removed during the first three years of rotation.

	Crude fat.	Crude fiber.	Crude protein.	Crude ash.	Carbohydrates.	Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Field corn, 1893	100.7	638.5	341.9	174.8	2,127.7	54.5	26.4	32.2
Crimson clover } 1894	237.6	108.1	909.3	439.0	4,962.4	70.8	19.5	42.7
Fodder corn } 1894						75.0	25.1	44.6
Fodder rye } 1895	170.2	446.1	569.6	355.1	2,693.6	27.3	17.3	44.6
Oats and peas } 1895						63.8	29.8	52.8
Total	508.5	1,192.7	820.8	968.9	9,783.7	291.4	118.1	216.9
Less amount added in fertilizer						24.1	140.3	101.6
Amount removed						267.3	—22.2	105.3

"The above tabulation of the amounts of fertilizing constituents added and removed thus far in the experiment shows that more phosphoric acid has been added than removed, while the amounts of nitrogen and potash removed were much greater than the amounts added."

Canadian cereals at the World's Columbian Exposition, F. T. Shutt (*Canada Exptl. Farms Rpt. 1895, pp. 226–232*).—Analyses (food constituents) are given of Canadian grown grain as follows: 49 samples of wheat, 12 of oats, 20 of barley, and 3 of buckwheat.

The author states that Canadian oats were characterized by a heavy kernel, a low percentage of moisture, a high content of albuminoids, and a large percentage of fat.

Field experiments with small grains and roots, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1895, pp. 5-41*).--Among the experiments conducted in 1895 were variety tests of peas and sugar beets, and variety and fertilizer tests with wheat, barley, oats, corn, mangels, turnips, carrots, and potatoes.

Alsike clover (*Michigan Sta. Rpt. 1895, p. 668*).—A reprint of Press Bulletin 7 of the station, giving brief notes upon culture and uses of this crop.

Culture of cowpeas, J. G. SMITH (*Florida Farmer and Fruit Grower, 9 (1897), No. 14, p. 214*).

On the forage crops in the Domain of Fraux, R. BOUILHAC (*Ann. Agron., 23 (1897), No. 3, pp. 97-113*).

Notes on Lathyrus sativus, with a comparative review of the poisonous properties of some allied leguminous plants, R. McDOUGALL (*Trans. and Proc. Bot. Soc. Edinburgh, 20 (1895), II, pp. 301-317*).

Millet, A. A. CROZIER (*Michigan Sta. Rpt. 1895, pp. 401-459*).—A reprint of Bulletin 117 of the station (E. S. R., 6, p. 713), with a supplementary chapter on Korean millets and additions to the list of names. Many of the illustrations given in the original bulletin are omitted in the reprint.

Potatoes, L. R. TAFT and U. P. HEDRICK (*Michigan Sta. Rpt. 1895, pp. 523-586*).—A reprint of Bulletin 119 of the station (E. R. S., 7, p. 297).

Rape as a forage plant, C. D. SMITH and F. B. MUMFORD (*Michigan Sta. Rpt. 1895, pp. 365-370*).—A reprint of Bulletin 114 of the station (E. S. R., 6, p. 632).

Types of tobacco and their analyses, F. B. CARPENTER (*North Carolina Sta. Rpt. 1895, pp. 331-366*).—A reprint of Bulletin 122 of the station (E. S. R., 8, p. 221).

Practical suggestions in reference to systematic and economical methods of using barnyard and chemical manures (*New Jersey Stas. Rpt. 1895, pp. 102-107*).—In this article the author gives some practical suggestions in the application of barnyard and commercial manures in 6 proposed rotations.

Tobacco, J. CRAIG (*Canada Exptl. Farms Rpt. 1895, pp. 130-133*).—Notes are given on 16 varieties of tobacco tested in 1895, and also a report on the value and qualities of 25 varieties of tobacco grown on the experimental farm in 1894, with a classification of the different varieties according to their adaptability for cigars, smoking and chewing tobacco, and cigarettes. The yields of dried leaf for the 12 varieties in 1895 are tabulated.

HORTICULTURE.

Field experiments with fertilizers (*New Jersey Stas. Rept. 1895, pp. 100-102*).—The methods used and the results secured in these experiments were given in detail in previous reports (E. S. R., 7, pp. 682, 683, 686). The present report gives a summarized statement of the results with different crops.

Sweet potatoes.—Commercial fertilizers used alone were found to be more profitable than barnyard manure alone, satisfactory crops having been obtained with the former. The two combined gave better results than barnyard manure alone. On sandy soils the addition of nitrogen to the commercial fertilizers and the use of barnyard manures increased the yield of sweet potatoes, but reduced their quality materially. On the best sweet-potato soils the use of nitrogen with commercial fertilizers, either as nitrate of soda or as dried blood, was unprofitable.

Early tomatoes.—Experiments with tomatoes were conducted on soils well adapted to their growth. Nitrate of soda was more profitable

than either commercial fertilizers or barnyard manure used alone, and gave nearly as good results. It was found better to apply the nitrate in two portions than to apply the whole quantity at once.

Peaches.—This experiment has been carried on for 11 years on soil well adapted to fruit culture. Manuring a peach orchard was found to be profitable. The period of profitable bearing of peach trees was extended by manuring. Complete fertilizers, whether commercial fertilizers or barnyard manure, were better than those containing a single fertilizing ingredient or a combination of two. The commercial fertilizers were more profitable than barnyard manure.

Strawberries.—In 3 experiments on soils well supplied with mineral fertilizers a strong top-dressing of nitrate of soda was found very profitable.

Edible fungi, L. M. UNDERWOOD (*Alabama College Sta. Bul. 73, pp. 337–346, figs. 3*).—Popular notes are given on mushrooms and their uses, and descriptions of 2 of the most common edible mushrooms growing in Alabama. The species described are *Agaricus campestris* and *Amanita cæsarea.* The author has drawn up contrasting characters by which poisonous *Amanita muscaria*, or fly agaric, may be readily distinguished from the edible *A. cæsarea.* Brief notes are also given on the puffballs, and some of the more important American bibliography relating to mushrooms is mentioned.

Experiments with mulching, B. D. HALSTED (*New Jersey Stas. Rpt. 1895, pp. 317, 318*).—Experiments were conducted to test the value of mulching for eggplants, peppers, cucumbers, and tomatoes. The eggplants gave a gain of 66.66 per cent in favor of the mulch, peppers 12.95 per cent, and tomatoes 11.30 per cent, while with cucumbers there was a loss due to a poor stand of plants but a gain of 4.52 per cent in keeping quality.

Fruit statistics, A. T. JORDAN (*New Jersey Stas. Rpt. 1895, pp. 151–167*).—The report is based on a fruit census taken by the State Station in coöperation with prominent horticulturists of the State. The object of the census was to learn the extent of commercial fruit growing, the methods used by practical men, and their successes and failures. The results of the work are to be given more in detail later. Some of the more general results are given below.

Total areas and their distribution.—One-tenth of all the farmers of the State are engaged in commercial fruit growing. Over 40,000 acres are devoted to this industry. The acreage in peach exceeds that of all other fruits taken together. The apple has the next greatest acreage; and that of the others in the order of rank are strawberries, pears, blackberries, raspberries, grapes, currants, cherries, gooseberries, quinces, and plums. The State is divided into northern, central, and southern sections, and the total acreage is given for each fruit in each of the 3 sections, fruits recently set, etc. A table is also given showing for the different counties the average acreage of each fruit under

the control of one man. A discussion of the peach industry shows that the "peach belt" is rapidly extending northward.

The general character of soils devoted to fruit growing.—The southern section consists principally of sandy or gravelly soils. The soils of the central section are about equally divided between clayey and the sandy classes. The northern section leads in mountain soils, but has nearly an equal amount of both sand and clay soils.

Kinds and varieties of fruits grown.—A list is given of the leading varieties of each fruit for each of the 3 sections of the State. A further discussion of this question is reserved for a future bulletin.

Does fruit growing pay?—The percentages of fruit growers who think fruit growing is profitable are as follows: Northern section, 77.6; central, 76; southern, 81.

Brief statistics are given on methods of preparing fruit for market and methods of selling fruit.

Field experiments with fertilizers upon peach trees, S. S. VOORHEES (*New Jersey Stas. Rpt. 1895, pp. 107–110*).—These experiments are in continuation of previous work (E. S. R., 7, p. 686). The plan, object, and conditions under which they are conducted are restated. Progress is reported upon them, but definite conclusions are reserved until their completion.

The orchard was divided into 3 plats. One was unmanured. The other 2 received muriate of potash, with nitrate of soda and boneblack in one case, and ground bone and ground fish in the other. The quantities and cost of the fertilizers applied and the yield and value of the crops in 1895 are tabulated, and a summary is given of the yield and value of all crops harvested to date. The yield in 1895 was much greater on the fertilized plats. The results of the experiments up to the present time seem to indicate that the more slowly available forms of nitrogen and phosphoric acid, ground bone, and ground fish give the best results.

Failure of pears to mature, B. D. HALSTED (*New Jersey Stas. Rpt. 1895, pp. 360, 361*).—An investigation was made of complaints of the failure of pears, particularly of the Keiffer variety, to mature their fruit. Several reasons combined to bring about this result. Among them are mentioned the dry weather of the summer and autumn, the lack of proper pruning, and the overloading of trees. There was considerable leaf blight present in many trees, and this may have assisted somewhat in the trouble.

Report of horticulturist, J. CRAIG (*Canada Exptl. Farms Rpt. 1895, pp. 75–130, figs. 11*).—Notes are given on the shipment of perishable fruits to England and the development of the fruit industry throughout the Dominion. An elementary treatise is given on the apple, its methods of culture, time and directions for planting, care of the fruit, etc., with descriptions of varieties for planting. The blossoming period for apples, pears, plums, and cherries is g[illegible]n for the different

parts of the Dominion. Notes are given on varieties of plums, raspberries, blackberries, and strawberries.

Some experiments are reported on the use of the sand cherry (*Prunus pumila*) as a stock for Morello cherries. Both for grafts and budding it proved unsatisfactory. When the sand cherry was crown and stem grafted upon American plum stocks, the union and growth secured were very satisfactory.

Extended variety tests of squashes were conducted in which the yield, size, appearance, and productiveness of 56 varieties were observed. The varieties recommended as best are Early Golden Bush, England Vegetable Marrow, New Pineapple, and Perfect Gem; of winter varieties, Hubbard takes the lead, although Bay State gives promise of being a useful variety. Butman proved of considerable merit on account of its keeping qualities.

Experiments with fertilizers on cranberries (*New Jersey Stas. Rpt. 1895, pp. 110–112*).—The objects of these experiments were "to study (1) the effect of different forms and kinds of fertilizer constituents upon the yield and quality of fruit, and (2) whether additional plant food would exert any influence in preventing cranberry scald." Outlines of the experiments are given with a description of the conditions under which they are conducted, and the plan of the plats with the amount and kind of fertilizers applied to each. Reports are given for the seasons of 1894 and 1895. Unfavorable weather conditions prevented the best results being obtained. In neither season were favorable results obtained in preventing scald.

In one of the bogs used in these experiments, the application of fertilizers gave very little increase in yield of berries. In another bog the greatest increase was obtained with ground bone and muriate of potash, and with nitrate of soda, acid phosphate, and muriate of potash. The next greatest increase was with acid phosphate and muriate of potash. A slightly smaller increase was obtained on plats fertilized with nitrate of soda and acid phosphate, with nitrate of soda and muriate of potash, and with ground bone and sulphate of potash. A still smaller increase attended the use of acid phosphate and muriate of potash singly. The least increase was with nitrate of soda and plaster used singly. An application of lime gave no increase. The use of ground bone and kainit was decidedly injurious, causing an excessive growth of vine with but little fruit. A more detailed report of these experiments is to be given later.

Notes on mushrooms (*Gardening, 19 (1897), No. 941, p. 29*).—Popular notes are given on mushroom culture.

Pruning tomatoes, D. D. SWARTLEY (*Florida Farmer and Fruit Grower, 9 (1897), No. 12, pp. 181, 182*).

Variety tests of vegetables, flowers, etc., S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1895, pp. 316–326*).—A report is given of the year's tests in Manitoba of varieties of carrots, corn, peas, cabbage, cauliflower, onions, celery, beets, lettuce, beans, radishes, tomatoes, cucumbers, peppers, asparagus, herbs, eggplant, spinach, tobacco, gladioli, roses, cannas, dahlias, and many other flowers and bulbs.

Variety tests of vegetables in the Northwest Territories, A. MACKAY (*Canada Exptl. Farms Rpt. 1895, pp. 346–360*).—Reports are given of variety tests of potatoes, turnips, mangel-wurzels, carrots, sugar beets, artichoke, asparagus, beets, beans, celery, table carrots, sweet corn, cucumbers, citrons, cabbage, cauliflower, lettuce, muskmelons, watermelons, parsnips, kale, onions (transplanted and sown in open ground), peas, parsley, radishes, spinach, rhubarb, table turnips, and miscellaneous annual and perennial flowers.

Variety tests of vegetables and fruits, W. M. BLAIR (*Canada Exptl. Farms Rpt. 1895, pp. 270–277*).—Reports are given on tests conducted in the maritime provinces of 6 varieties of beans, 6 of muskmelons, 2 of watermelons, 8 of cucumbers, 8 of onions, 4 of parsnips, 5 of carrots, 5 of beets, 5 of sweet corn, 15 of garden peas, 9 of radishes, 17 of tomatoes, 9 of lettuce, 15 of cabbage, 13 of cauliflower, 17 of celery, 3 of asparagus, 2 of hops, 6 of tobacco, 14 of strawberries, 9 of grapes, 11 of currants, 15 of gooseberries, 10 of raspberries, 4 of black raspberries, 5 of blackberries, and several of dwarf Juneberries, and notes on the fruiting of 40 varieties of apples, 9 of cherries, and 8 of plums.

Variety tests in British Columbia, T. A. SHARPE (*Canada Exptl. Farms Rpt. 1895, pp. 387–411, fig. 1*).—A report is given of variety tests of apples, pears, plums, cherries, peaches, nectarines, apricots, mulberries, quinces, figs, medlars, filberts, grapes, currants, gooseberries, Juneberries, blackberries, raspberries, strawberries, garden peas, beans, sweet corn, table turnips, carrots, beets, parsnips, radishes, cabbage, cauliflower, onions, tomatoes, squashes, pumpkins, asparagus, parsley, celery, lettuce, muskmelons, and cucumbers.

Vegetable novelties and notions, L. R. TAFT, H. P. GLADDEN, and U. P. HEDRICK (*Michigan Sta. Rpt. 1895, pp. 537–548*).—A reprint of Bulletin 120 of the station (E. S. R., 7, p. 302).

Trucking in the South, W. F. MASSEY and H. B. BATTLE (*North Carolina Sta. Rpt. 1895, pp. 30–95*).—A reprint of Bulletin 112 of the station (E. S. R., 7, p. 404).

Report of the horticulturist, J. T. STINSON (*Arkansas Sta. Bul. 43, pp. 75–105*).—A report is given of variety tests at the station and elsewhere of strawberries, raspberries, grapes, peaches, and apples. Notes are also given on the choice of location and soil for these different fruits and the best methods of planting and training to be followed.

Report of the horticulturist, L. R. TAFT (*Michigan Sta. Rpt. 1895, pp. 159–170*).—A résumé is given of the work done by the department at the station and at the South Haven Substation during the year. Variety tests and investigations on insecticides, fungicides, and commercial fertilizers have been continued, and an irrigation plant for the fruit and vegetable garden has been established.

Heating greenhouses, L. R. TAFT (*Florists' Exchange, 9 (1897), No. 14, pp. 334–336*).

Irrigation of garden crops, B. D. HALSTED (*New Jersey Stas. Rpt. 1895, pp. 309–317*).—Reprinted from Bulletin 115 of the stations (E. S. R., 8, p. 127).

The apple orchard, L. R. TAFT (*Michigan Sta. Rpt. 1895, pp. 644–667, figs. 5*).—Reprinted from Bulletin 124 of the station (E. S. R., 7, p. 303).

Russian cherries, U. P. HEDRICK (*Michigan Sta. Rpt. 1895, pp. 641–643*).—Reprinted from Bulletin 123 of the station (E. S. R., 7, p. 305).

Fruits at the substation, T. T. LYON (*Michigan Sta. Rpt. 1895, pp. 460–522*).—A reprint of Bulletin 118 of the station (E. S. R., 7, p. 214).

Cultivation of the peach tree, W. F. MASSEY and G. MCCARTHY (*North Carolina Sta. Rpt. 1895, pp. 285–315, figs. 22*).—A reprint of Bulletin 120 of the station (E. S. R., 8, pp. 50, 68).

Native plums, U. P. HEDRICK (*Michigan Sta. Rpt. 1895, pp. 636–640*).—A reprint of Bulletin 123 of the station (E. S. R., 7, p. 305).

The shaddock or grape fruit, J. H. HART (*Amer. Jour. Pharm., 69 (1897), No. 4, pp. 181, 182*).—The author maintains that these two names which are commonly confused refer to two distinct fruits.

The currant, W. M. MUNSON (*Amer. Gard., 18 (1897), No. 119, p. 241*).—Notes are given of currant propagation, pruning, varieties, and marketing.

The pearl gooseberry (*Amer. Gard., 18 (1897), No. 119, pp. 237, 238, fig. 1*).—This prolific variety is figured and described.

The cultivated raspberries, A. A. CROZIER (*Michigan Sta. Rpt. 1895, pp. 252–324*).—A reprint of Bulletin 111 of the station (E. S. R. 6, p. 299).

Small fruit notes, L. R. TAFT and H. P. GLADDEN (*Michigan Sta. Rpt. 1895, pp., 624–635*).—A reprint of Bulletin 122 of the station (E. S. R., 7, p. 306).

Protection of grapevines against spring frosts, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 11, pp. 311–313*).—Various methods are suggested, among them irrigation, spraying, smudges, etc.

Training of grapes, A. OGER (*Rev. Hort., 69 (1897), No. 6, pp. 124–128, figs. 9*).—A description is given of the Oger system as applied in the Thomery vineyards.

Pecan grafting, J. H. GIRARDEAU (*Florida Farmer and Fruit Grower, 9 (1897), No. 12, p. 179*).

The influence of soils on the color of hydrangeas, H. MOLISCH (*Bot. Ztg., 55 (1897), No. 3, pp. 49–61*).

Methods of propagating ornamental and forest trees from seed (*Gard. Chron., ser. 3, 21 (1897), No. 536, pp. 214, 215*).

Street planting and shade trees, H. C. BLISS (*Proc. Amer. Forest Assn., 11 (1897), pp. 187–192*).

Results of experiments with roses, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1895, pp. 54–58, figs. 3*).—Notes are given on planting, treatment, injurious insects, and winter protection of roses, and a descriptive list of 36 of the more desirable roses for cultivation in Ottawa.

The American Fruit Culturist, J. J. THOMAS (*20th edition, revised and enlarged by W. H. S. Wood. New York: Wm. Wood & Co., 1897, pp. XV, 758, figs. 796*).—The rapid progress made in recent years in the culture of fruit has made it desirable to present a revised edition of this well-known work on horticulture, in which is given practical directions for the propagation and cultivation of the different fruits adapted to the United States.

In the present edition the work is confined strictly to the propagation and cultivation of those fruits which are grown in the open air. The fruits of California and the Pacific Coast are not specially treated of, there already being a voluminous literature on this subject. Numerous new chapters have been added in place of those omitted from the previous editions, and other parts have been entirely rewritten. The sections on tropical and subtropical fruits have been especially prepared by E. H. Hart, a well-known specialist in the cultivation of these fruits. The chapter on spraying was contributed by L. H. Bailey, and the descriptions of Russian apples are by J. L. Budd. The chapters on insects and diseases, on account of more extended information relating to these subjects, have been almost entirely rewritten, and new chapters on nuts and wild fruits are included. Descriptive lists and indexes of the names of most of the varieties of fruits cultivated in the United States, either locally or of wide distribution, are given with reference to the object of the work. A glossary and general index are also appended.

The laborious work of revising and editing this work seems to have been well done, although there are a few points to which exception might be taken. The statement that the pawpaw tree is diœcious will hardly be generally accepted, although there frequently appears to be evidence which indicates a lack of pollination rather than a true bisexuality. In the chapters relating to agricultural experiment stations, the author has apparently confused the establishment of agricultural colleges and the act founding the experiment stations.

The work on the whole seems to be well done, the numerous illustrations are of a good quality, and it will undoubtedly prove a valuable addition to the horticultural literature of the country.

FORESTRY.

Forestry report, W. T. MACOUN (*Canada Exptl. Farms Rpt. 1895, pp. 58–69, pl. 1*).—A tabulated record is given for the different species of forest trees, showing their average growth and present condition, with notes on 24 species. The dates of blooming are given for several of the trees and shrubs.

Forest trees, A. MACKAY (*Canada Exptl. Farms Rpt. 1895, pp. 360–363*).—Notes are given on the present condition of shrubs and trees planted in 1894, with a report on the amount of labor required for the culture of the forest plantations during the past year.

Concerning smoke injury to firs, B. BORGGREVE (*Ztschr. Forst. und Jagdw., 29 (1896), No. 3, pp. 159–176*).—A controversial article replying to R. Hartig.

Effect of lightning upon trees, R. HARTIG (*Forstl. naturw. Ztschr., 6 (1897), No. 3, pp. 97–120, figs. 82*).

The aspen and its uses (*Garden, 51 (1897), No. 1325, pp. 257, 258*).

The value of willow timber, A. D. WEBSTER (*Gard. Chron., ser. 3, 21 (1897), No. 536, p. 216*).

Australian and other foreign trees growing unprotected in Arran, D. LANDSBOROUGH (*Trans. and Proc. Bot. Soc. Edinburgh, 20 (1896), III, pp. 508–531*).

Influence of groves on the moisture content of the air, L. C. CORBETT (*Forester, 3 (1897), No. 4, p. 48*).—An average higher humidity amounting to 4.79 per cent is noted for the spring and summer months in groves over that in the open.

The cultivation of willows, F. R. MEIER (*Forester, 3 (1897), No. 4, pp. 54, 55*).

The mineral food of conifers, A. C. FORBES (*Gard. Chron., ser. 3, 21 (1897), No. 535, p. 200*).

Observations on the destructive effects of wind and the protection afforded by woodlands and wind-breaks, F. H. KING (*Proc. Amer. Forest. Assn., 11 (1897), pp. 125–130*).

The tamarack pine, C. A. PURPUS (*Forstl. naturw. Ztschr., 6 (1897), No. 3, pp. 125–127*).—Notes are given of *Pinus murrayana*.

The relation of insects and birds to the present forest conditions, A. D. HOPKINS (*Proc. Amer. Forest. Assn., 11 (1897), pp. 173–176*).

Plant protection, H. FÜRST (*Die Pflanzenzucht im Walde. Berlin: J. Springer, 1897, pp. X, 368, figs. 52*).—A handbook for foresters and students.

SEEDS—WEEDS.

Report of the seed-control station at Vienna, Austria, 1895-'96, T. RITTER VON WEINZIERL (*Chem. Ztg., 21 (1897), No. 18, p. 157*).—In addition to the usual seed testing, the station conducted experiments on the germination of hard clover seed; comparative experiments in testing the methods of the German Association and the methods of this station; testing apparatus for beet seed germination, etc.; field tests with fodder plants, employing various grass mixtures; miscellaneous field tests at Melk and Marshfield, in Lower Austria; and experiments with alpine fodder plants. The work of seed testing shows a considerable increase in the number of samples tested over the previous year. In all, 18,779 analyses were made during the year ending July 31, 1896.

Tests of the vitality of grain and other seeds, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1895, pp. 51–53, fig. 1*).—A report is given of

1,776 tests conducted during the season of 1895, the most of which were on wheat, barley, and oats. The average vitality of these cereals was lower than that shown by the tests in 1894. Tables are given showing in detail the results of tests for vitality and also the results of grain tests for each province.

Work with weeds, B. D. HALSTED (*New Jersey Stas. Rpt. 1895, pp. 346–355*).—Illustrated descriptive notes are given of several of the worst weeds and poisonous plants. Two of the recent additions to the weed flora of the State are field bugloss (*Lycopsis arvensis*) and false flax (*Camelina sativa*). The occurrence of the Russian thistle (*Salsola kali tragus*) is also mentioned. Further notes are given on spotted cowbane, wild parsnip, jimpson weed, poke root, and mountain laurel, all of which are more or less poisonous to animals or persons.

On the germination of Bromus secalinus, W. J. BEAL (*Bot. Gaz., 23 (1897), No. 3, p. 204*).—Notes are given of the germination of chess in contact with ice. Plumules ½ in. long were developed, and roots 2 in. in length had imbedded themselves into the ice.

The wild onion or sweet-scented garlic, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 8 (1897), No. 1, pp. 23, 24, pl. 1*).—Notes are given of *Allium fragrans*, a very troublesome weed.

Beggar weed, H. G. HASTINGS (*Florida Farmer and Fruit Grower, 9 (1897), No. 14, p. 214, fig. 1*).—A description is given of *Desmodium molle*, with directions for its culture and handling.

Plants reputed to be poisonous to stock in Australia, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 8 (1897), No. 1, pp. 1–22*).—Notes are given on plants representing 25 families that are considered poisonous to stock. Numerous references to Australian as well as other literature on poisonous plants are given.

Some specially noxious weeds, J. FLETCHER (*Canada Exptl. Farms Rpt. 1895, pp. 177–181, figs. 5*).—Illustrated descriptive notes are given on the hare's ear mustard (*Erysimum orientale*), the tumbling mustard (*Sisymbrium sinapistrum*), and penny cress (*Thlaspi arvense*).

DISEASES OF PLANTS.

Report of the botanist, B. D. HALSTED (*New Jersey Stas. Rpt. 1895, pp. 249–361, figs. 70*).—The work of the botanical department for the year was divided between field experiments and investigations in the herbarium and laboratory. Among the chief lines of investigations were testing of fungicides upon various garden vegetables, irrigation of garden crops, and prevention of potato scab and soil rot of sweet potatoes. Several fungus diseases of garden crops and ornamental plants were studied in the laboratory, but the investigations were not sufficiently advanced to admit of a report. During the year the station herbarium was enlarged by the addition of about 2,500 specimens. Some horticultural and other work is noted elsewhere in this number of the Record.

Experiments with turnips (pp. 250–267).—The experiments with fungicides upon turnips were in continuation of those reported in Bulletin 108 of the station (E. S. R., 6, p. 994), the object being to find some

cheap and efficient remedy for the prevention of club root. A résumé of the treatment and results of previous years' work is given, together with the details of experiments conducted in 1895.

A summary of the author's conclusions shows that kainit did not give favorable results, and that ashes, while they acted as a fertilizer and increased the size of the roots, are not to be recommended as a remedy for club root. The use of gas lime did not reduce the amount of club root, and this fungicide seriously interfered with the growth of the crop. Bordeaux mixture and ammoniacal copper carbonate were tested, but with negative results. Copper sulphate when applied as a powder at the rate of 1,200 lbs. per acre was injurious to the crop and did not diminish the amount of club root, but when the amount was reduced to 600 lbs. per acre the stand was good and the clubbing somewhat reduced in the second crop. Corrosive sublimate, both in the liquid and powder form, was tested, the results showing that the disease was somewhat reduced by its use. The best results were obtained by the use of air-slacked lime, and the experiments indicated that not more than 150 bu. nor less than 75 bu. per acre should be used on badly infected land. The application is most valuable when made in the fall and the lime left on the surface during the winter.

Experiments with potatoes (pp. 267–283).—The experiments here reported are largely reprinted from Bulletin 112 of the station (E. S. R., 7, p. 780). An account is given of the testing of various fungicides for the prevention of potato scab on Irish potatoes and soil rot of sweet potatoes. The superiority of corrosive sublimate to Bordeaux mixture for soaking seed as a preventive treatment for scab was demonstrated. Field tests where manure was added to the plats in considerable quantity showed an increase in the amount of scab present on the tubers. The use of lime appeared to increase the amount of scab. In one set of experiments the use of kainit seemed to greatly reduce it, as did sulphate of copper, but when the latter fungicide was used the yield was small. Where corrosive sublimate was used as a soil treatment the crop was nearly ruined, the stand of plants being only about 10 per cent of that of the checks. Sulphur gave the most favorable results on both experimental fields, showing a marked superiority over corrosive sublimate. Simply rolling or dusting the cut seed in sulphur reduced the scab to 5 per cent in one lot of 5 experiments, while the check plats contained as much as 47 per cent of diseased tubers. At the college farm dusting the seed and placing a little sulphur in the open row reduced the percentage of scab from 100 to 5 per cent. It was estimated that the cost of the sulphur and its application would be about $1 per acre.

The experiments which were conducted for the treatment of rot of sweet potatoes showed that the largest percentage of disease was on plats receiving manure. In this respect they agree with previous results given in Bulletin M of the station (E. S. R., 3, p. 703). The use of

kainit, sulphate of copper, lime, and corrosive sublimate showed that each was capable of reducing to some degree the amount of disease, but the best results were obtained upon the plat where sulphur was used at the rate of 625 lbs. per acre. It is suggested that instead of applying the sulphur broadcast a smaller amount might be successfully used by mixing the sulphur with 5 times its bulk of fine earth, and dropping a spoonful of the mixture in each hill before setting the plants.

Experiments with beans (pp. 283-292).—These experiments, which were in continuation of those reported in Bulletin 108 of the station (E. S. R., 6, p. 996), were conducted principally with a view of testing methods for the prevention of bean anthracnose. A review of the results obtained in 1894 is given. The results of 1895 show that ammoniacal copper carbonate did not prove as efficient as Bordeaux mixture when half strength solutions were used. The experiments with eau celeste gave good results, followed closely by those in which a neutral solution of copper sulphate was used. Sulphid of potassium gave no indications of fungicidal properties when applied to beans. The third crop upon the same land showed more than four times as much pod spotting as the first crop grown at the same time upon adjoining new land.

A test was made of the effect of irrigation upon beans, in which it was shown that while the yield of good pods was more than doubled the yield of diseased pods were increased fourfold. Mulching with diseased pods of the previous crop greatly increased the amount of diseased pods produced.

Experiments with tomatoes (pp. 293-296).—Plat experiments were conducted with tomatoes in continuation of those reported in Bulletin 108 of the station (E. S. R., 6, p. 995), in which numerous fungicides were tested for the prevention of diseases of tomatoes, the principal of which were leaf spot (*Septoria lycopersici*) and anthracnose (*Glœosporium phomoides*). Neither the experiments of 1894 nor 1895 gave striking results for any of the fungicides. This may be due partially to the fact that the diseases were not very prevalent on any of the plants either year. Bordeaux mixture reduced the fruit decay about one-half, while copper sulphate, eau celeste with and without soap, and potassium sulphid, were worthless.

Experiments with peppers (pp. 297-299).—Experiments for the prevention of anthracnose of peppers were begun, but the disease was present in such small amount that the results did not indicate the superiority of any fungicide.

The favorable effect of irrigation on peppers was shown by largely increased yield and a greatly prolonged period of fruitfulness.

Experiments with eggplants (pp. 299-302).—Experiments were carried on with sulphate of copper, Bordeaux mixture, eau celeste, and potassium sulphid for the prevention of diseases of the eggplant, the principal of which are leaf spot and fruit rot. Of the fungicides tested Bordeaux mixture gave the only satisfactory results. Mulching egg-

plants proved successful not only in increasing the yield, but the plats receiving the mulch contained less fruit rot than the others.

Experiments with cucumbers (pp. 303–305).—Experiments were conducted on 2 plats for the prevention of anthracnose (*Colletotrichum lagenarium*) and mildew (*Plasmopara cubensis*) which indicated that both diseases may be successfully combated by the use of fungicides. Of those tested Bordeaux mixture gave the best results. It not only increased the yield but preserved the fruit from ripening. Sulphate of copper solution ranked next and eau celeste third of the fungicides applied, while potassium sulphid gave negative results. The author states that mulching is beneficial in preventing the decay of fruits. The effect of pruning was to shorten the crop without any compensating gains.

Experiments with celery (pp. 306–309).—The effect was studied of Bordeaux mixture, neutral solution of copper sulphate, ammoniacal copper carbonate, potassium sulphid, and eau celeste for the prevention of celery blight. The plants were sprayed with the same solution 5 times at intervals of about 10 days. While there was no great amount of blight present, Bordeaux mixture gave the largest yield with the least percentage of destruction, followed by neutral solution of copper sulphate and ammoniacal copper carbonate in the order named.

The effect of irrigation was also studied, and it was found that the non-irrigated rows showed a larger percentage of blight than the watered ones. Irrigation increased the marketable crop threefold in weight and in value about eightfold.

Fungicides and spraying (pp. 319–345).—The formulas for the fungicides used in the foregoing experiments, methods of application, and various notes concerning their use are given.

Abnormal growths due to fungi (pp. 355–360).—Notes are given on witch's brooms, rust distortions, club root malformations, root knots of young trees, etc.

A bacterial disease of the tomato, eggplant, and Irish potato, E. F. SMITH (*U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 12, pp. 28, pls. 2*).—The attention of the author was first drawn to this disease by the statement of B. D. Halsted that it was due to the same microörganism as that causing the bacterial wilt of cucumbers and cantaloupes.[1] During the author's study of the cucurbit disease it became evident that the two diseases were due to different causes.

In 1895 diseased tomato plants were studied and inoculations made in the laboratory and greenhouse. From these diseased specimens an organism was separated wholly unlike that of the cucumber wilt, and numerous satisfactory infections were made upon living potato and tomato plants. In August, 1895, the author found what appeared to

[1] Mississippi Sta. Bul. 19 (E. S. R., 3, p. 702).

be the same disease in eggplants, and inoculations made upon vigorous tomato shoots showed the probable identity of the disease on the different plants. During the past year all the experiments of 1895 were repeated many times upon the tomato and potato, leaving no doubt as to the existence of a bacterial disease, or as to the particular organism to which it is to be attributed. The disease was repeatedly produced from pure cultures, and the same organism has been reisolated and a second series of successful inoculations instituted. The investigations are not considered complete, but they have advanced sufficiently far to make it advisable to put on record what has been learned concerning the parasite.

The cause of the disease is a bacillus, to which the name *Bacillus solanacearum* has been given, which is briefly characterized as follows: A medium-sized bacillus, with rounded ends; often in pairs, with a plain constriction; elliptical, varying in size with the age of the culture or length of time the tissues of the plants have been occupied; usually $1\frac{1}{2}$ to 3 times as long as broad. Cover-glass preparations 48 hours old stained with methyl violet show many specimens 1.5 by 0.5μ. The organism is but slightly motile, especially when taken from the plant, but in young cultures sometimes becomes very actively so. The flagella are much longer than the rod, but the exact number and place of attachment was not made out. No spores have been observed either in the plant or culture media. Zoogloea are formed almost from the start in the upper layers of the fluid culture media.

The first prominent indication of the disease is the sudden wilting of the foliage, which may occur first on a single shoot, but finally affects the whole plant. Subsequently, if the plant is young and not very woody, the stem shrivels, changing to a yellowish-green and finally to brown or black. The vascular bundles become brown before the shriveling takes place, and in the potato often show through the outer green parts of the stem as long dark streaks. The vessels of such bundles are filled with the bacilli, which ooze out when the stem is cut across. If bacteria are abundant the wilt is often sudden, the foliage wilting without the preliminary yellowing. The progress of the disease seems to be more rapid in young than in old plants and in hot than cold weather. In the case of the potato the tubers are finally attacked and destroyed. A brown or a black rot ensues, beginning at the stem end of the tuber in the vascular ring and extending in all directions.

The anatomical changes in the host plant have not been worked out fully, but it appears that the starch grains are uninjured by the organism, and lignified tissues are not affected by it. The organism attacks the parenchyma of the pith and bark and also destroys the protoplasm, converting nearly the whole interior of soft stems into a mass of broken-down cells mingled with bacteria. In old and well-lignified stems, like those of well-grown tomatoes and eggplants, the outline of the stem is better preserved and the lesions are less extensive. In the tubers of

the potato well-defined cavities arise in the vicinity of the vascular ring, which are filled with loose starch grains, remnants of cells, and bacteria.

The behavior of the bacillus in bouillon and peptone cultures, milk, litmus milk, gelatin, agar, potato cultures, and fermentation tubes is given in detail. In none of the cultures was there any gas produced, and the bacillus seems to be strictly aërobic. No acid reaction could be detected in any stage of the culture, while, on the contrary, the organism is a very vigorous alkali producer.

The thermal death point of the organism is determined at about 52° C., 10 minutes' exposure. It grows well in a thermostat at 37°, which is slightly higher than the outside summer temperatures. The minimum temperature for growth seems to be about 13°, but the temperature at which the organism is destroyed by cold was not ascertained; temperatures of −77° C. for 20 minutes failing to kill all the germs. The bacillus readily takes the various anilin stains, and it forms a rather characteristic brown pigment in the host plants and in culture media containing grape, fruit, or cane sugar.

The host plants for this disease are, as has already been stated, the tomato, potato, and eggplant, but experiments show that it will also affect many other solanaceous plants.

Little is known about the geographical distribution of this disease, but it is known to occur in Mississippi and Alabama, along the coast in the vicinity of Charleston, South Carolina, and near Washington, District of Columbia. It probably exists in many place and is confounded with other diseases.

Investigations were conducted to ascertain the natural methods of infection, and it was found that the Colorado potato beetle would very readily carry the disease from one plant to another, and it is probable that insect enemies are largely responsible for the spread of the disease.

As preventive measures, the destruction of all leaf-eating and leaf-puncturing insects is the first thing to be considered. Early and complete removal of diseased vines, and in the case of the potato the prompt digging of tubers and their immediate use or storage in a cool dry place; rotation of crops; and selection of seed and tubers from plants grown where the disease is not prevalent are other suggestions of possible value in preventing the spread of this disease.

In conclusion, the author draws up contrasting characters between *Bacillus tracheiphilus* (the cause of the cucurbit wilt), Kramer's bacillus, and the one under consideration.

Spraying experiments, J. CRAIG (*Canada Exptl. Farms Rpt. 1895, pp. 116–122*).—A report is given of coöperative experiments on the use of Bordeaux mixture to which Paris green is added for the prevention of various apple diseases. The formula used was copper sulphate 4 lbs., lime 4 lbs., Paris green 4 oz., and water 50 gal. In nearly every

case reported the product of the sprayed trees was of considerably better quality than of the unsprayed.

The efficiency of arsenate of lead and Paris green applied with and without Bordeaux mixture was tested, and it was shown that the relative efficiency of the insecticides with and without Bordeaux mixture was as follows:

Average percentage of wormy fruit.

	Per cent.
Arsenate of lead and Bordeaux mixture	2.15
Arsenate of lead	5.60
Paris green	6.38
Paris green and Bordeaux mixture	6.64
Bordeaux mixture	7.46
Unsprayed	14.45

Lysol, which has been particularly recommended as a preventive for peach curl, was tested in the greenhouse on a number of plants, 2 applications being given in which 1, 2, 3, and 4 per cent solutions were used. With the exception of a solanaceous greenhouse plant and heliotrope, no injury was done by the applications. A 1½ per cent solution of lysol was sprayed upon peach trees with no injurious effect, while a Bordeaux mixture of 3 lbs. each of copper sulphate and lime and 2 oz. of Paris green to 45 gal. of water badly damaged the foliage.

Smuts in small grain, J. FLETCHER (*Canada Exptl. Farms Rpt. 1895, pp. 141, 142, fig. 1*).—Brief notes are given on the occurrence of smut, and soaking the seed in different strengths of a solution of copper sulphate and water for different lengths of time, or sprinkling the solution over the grain is recommended.

Diseases of carnations, J. DOUGLAS (*Gardening, 19 (1897), No. 940, p. 16*).—Notes are given on rust, spot, bacteriosis, and maggot.

A new California rust, E. W. D. HOLWAY (*Erythea, 5 (1897), No. 3, p. 31*).—*Puccinia cretica* parasitic on *Cressa cretica* is described.

Combating grain rusts, G. STAES (*Tijdschr. Plantenziekt, 2 (1896), pp. 43, 44*).—A brief note on the use and efficiency of Cerespulver.

The grain rusts, G. STAES (*Tijdschr. Plantenziekt, 2 (1896), pp. 144–169, figs. 11*).—A review of Eriksson's work on the grain rusts is given.

Studies on the hexenbesen rust of barberry, J. ERIKSSON (*Beiträge Biol. Pflanzen, 8 (1897), No. 1, pp. 14, pls. 2*).—Notes on *Puccinia arrhenatheri* are given.

Brown rot of cherries, J. RITZEMA BOS (*Tijdschr. Plantenziekt, 2 (1896), pp. 126–130*).—Notes are given of *Monilia fructigena*.

The Exoasceæ, C. DESTRÉE (*Tijdschr. Plantenziekt, 2 (1896), pp. 81–89, figs. 4*).—Notes are given on the life history of *Exoascus pruni*, *E. deformans*, *E. cerasi*, *Taphrina aurea*, and *T. bullata*.

Leaf curl of peaches, G. STAES (*Tijdschr. Plantenziekt, 2 (1896), pp. 74–80, figs. 3*).—Notes are given on *Exoascus deformans*. All diseased leaves and twigs should be collected and burned and the usual means taken for protecting trees from the fungi.

Fungus diseases of plants, P. NIJPELS (*Les maladies cryptogamiques des plantes cultivées. Liége: Vaillant-Carmanne, 1896, pp. 96, ill.*).

Summer, autumn, and spring treatment for chlorosis of the grape, J. TERASCH (*Weinlaube, 1896, No. 45, pp. 530, 531*).

The mildew, or oïdium, of grapes, G. STAES (*Tijdschr. Plantenziekt, 2 (1896), pp. 10–17, fig. 1*).—Notes are given on *Uncinula spiralis*, or *Oïdium tuckeri*, with suggestions for its prevention, potassium sulphid being recommended.

The damping off of seedlings, J. RITZEMA BOS (*Tijdschr. Plantenziekt, 2 (1896), pp. 1-4*).—Notes are given on attacks of *Pythium debaryanum* on various seedlings.

Plant galls formed by insects, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 10, pp. 695-699*).—Notes on some passive means of defense.

An injurious disease of cañaigre, P. HENNINGS (*Notisbl. Kgl. bot. Gart. und Museums, Berlin, 1897, No. 7, pp. 238, 239*).—Notes are given of a destructive leaf disease of cañaigre, which is caused by *Ovularia obliqua* var. Picking diseased leaves, spraying with copper sulphate solutions, and destruction of all allied plants are suggested means for preventive treatment.

Notes on the Erysipheæ, C. E. DESTRÉE (*Tijdschr. Plantenziekt, 2 (1896), pp. 5-10, figs. 6*).

Forest fungi, anthracnose of poplars, B. D. HALSTED (*Proc. Amer. Forest. Assn., 11 (1897), pp. 176-178*).—Notes are given of the injury done to young poplars by *Marsonia populi*.

Lathræa squamaria on conifers, VON TUBEUF (*Forstl. naturw. Ztschr., 6 (1897), No. 3, pp. 124, 125*).—Notes are given of the parasitism of this plant on *Picea excelsa*.

On some species of the genus Urophlyctis, P. MAGNUS (*Ann. Bot., 11 (1897), No. 41, pp. 87-96, pls. 2*).—Notes are given of the synonymy of some of the species of these parasites, *Urophlyctis pulposa*, *U. major*, and *U. kriegeriana* being discussed at some length. Their attacks upon their hosts—beets, parsnips, etc.—result in tumor-like swellings.

Pear blight, J. T. STINSON (*Arkansas Sta. Bul. 43, pp. 117-120*).—The author recommends for the treatment of pear blight that given by M. B. Waite in the Yearbook of this Department for 1895 (E. S. R., 8, p. 796).

Some injurious fungus diseases, J. CRAIG (*Canada Exptl. Farms Rpt. 1895, pp. 122-124, figs. 3*).—Descriptive notes with suggestions for prevention of grape anthracnose, raspberry anthracnose, leaf spot of the violet, and carnation rust.

Diseases of plants induced by cryptogamic parasites, K. FREIHERR VON TUBEUF (*English edition by W. G. Smith. London and New York: Longmans, Green & Co., 1897, pp. XV, 598, figs. 330*).—The author of this edition offers an unnecessary apology for presenting a translation and revised edition of this valuable publication.

The work, which is intended to deal only with those diseases of plants produced by cryptogamic organisms, is divided into two parts, the first of which is more or less general in its nature and is practically a translation of the original with certain modifications found necessary in adapting the work to the requirements of English readers; while the second part, to which many additions have been made, is a systematic arrangement of cryptogamic parasites. The chapters discussed in the first part of the work are: Parasitic fungi; reaction of the host to parasitic attack; relation of parasite and substratum; natural and artificial infection; disposition of plants to disease; preventive and combative measures; economic importance of diseases of plants; and symbiosis, which is discussed under two heads, mutualism and nutricism.

The second part treats of the pathological phenomena, together with a description of the organism producing them. Where diseases are of economic importance, measures for prevention and extermination are also suggested. Necessarily the book contains a more complete list for Germany and adjoining countries than for other regions, yet the editor of the present edition has included and brought up to a quite recent date most of the important work in America, Great Britain, and elsewhere.

The chapters of the second part are: (1) Pathogenic fungi of plants, under which heading are treated the lower fungi, Chytridiaceæ, Zygomycetes, and Oomycetes; the higher fungi, which include Ascomycetes, Ustilagineæ, and Uredineæ, Basidiomycetes, and the fungi imperfecti; (2) pathogenic slime-fungi; (3) pathogenic bacteria; and (4) pathogenic algæ. A complete index of parasites and a general index complete the volume.

The illustrations of this work, most of which are very well executed, are given to illustrate pathological objects rather than to give drawings of microscopical subjects, the author considering it more essential in this work to show the effect of the fungus upon the host. Some of the illustrations are from the older works, but most of them are from drawings and photographs made by the author.

In this edition certain portions have been entirely rewritten from the original edition, which appeared in 1894. As has already been stated, the editor has included many references to comparatively recent literature.

In the discussion of pathogenic bacteria one very important contribution to the subject seems to have been overlooked, namely, that of E. F. Smith on the wilt of Cucurbits, which is due to *Bacillus tracheiphilus*, originally published in the *Centralblatt für Bakterologie und Parasitenkunde, Allg., 1 (1895), p. 364.*

A few other omissions of American literature which may not have been available to the editor are noticed, but the great value of the work is not seriously impaired by their absence.

On the whole, it will probably be found the most recent and valuable work on this subject in the English language.

ENTOMOLOGY.

The apiary: Report for year ending June 30, 1895, R. L. TAYLOR, (*Michigan Sta. Rpt. 1895, pp. 186–223*).—The author gives here the results of experiments relating to (1) spring protection and stimulative feeding, (2) comb foundation, (3) foul brood, (4) feeding back, (5) the prevention and management of swarming, (6) Conser's non-swarming hive, (7) wintering, (8) spring packing, and (9) a general discussion of the economy of the hive.

Spring protection and stimulative feeding.—The experiments were begun with upward of 80 hives, but owing to losses and other circumstances, the number was reduced to 61. Of these 9 two-story and 12 one-story Heddon hives, on April 10 were packed with sawdust, so that there was a layer of 2 to 3 in. in front, 3 in. on top, and 4 in. on the back. Where 2 hives were adjacent, the intervening space was simply filled up. Finally the hives were divided into 2 classes: (1) Those requiring 2 sections of the Heddon hive, and (2) those for which 1 section would be sufficient.

Feeding was begun at the close of the apple blossom season (May 20) and continued until June 10. One pound of thin sirup (made of 1 lb. sugar and 2 lbs. water) was fed daily at the entrance in Simplicity feeders, when the bees would take that much. The amount taken seemed to depend upon the weather.

Contrary to what had been expected, no great advantage was found to result from such protective treatment. In every way the unpacked colonies excelled the others in the increase of stored honey and in weight. Stimulative feeding resulted advantageously to a trifling extent in three instances and disadvantageously in a fourth instance.

In connection with these results the author brings out the fact that

the series of experiments do not support the assertion frequently made that large brood chambers tend to prevent swarming. In 11 cases swarms were cast by large hives and in only 4 cases by small ones.

Comb foundation tests.—Experiments were made to determine the relative desirability of and the reasons for differences in different brands of foundation. Seven brands were tried, viz, Van Deusen, Given, Dadant, Hunt, Root, Given-Hunt, and Root-Hunt. During the preceding year such experiments had been made but resulted in a partial failure, since sections of too great a width were employed. This year, however, the results were very gratifying. Four cases of sections were employed and of these a whole one was devoted to a comparison of the Hunt and the Given, and another to a comparison of the Van Deusen and the Given. To the other brands only half a case was devoted.

Summarizing the results, the author says that "the quality of the wax, either in its original characteristics or in the method of its manipulation previous to the final process of melting it, cuts a considerable figure," as is shown by the fact that in one instance the comb from one of two samples contained more than 28 per cent more honey than the other, although the two samples were made on the same machine and were of almost equal weight. Further, the kind of machine used affects the results; and light foundation is inferior to heavy.

Of the different samples used, that of the Hunt foundation is commended most highly, since it excels the Given by 6½ per cent, but the latter is 18 per cent better than the best of the others.

The comparative value of the different brands with respect to the thinness to which the bees draw it out into comb was also determined, and the figures of the measurements are tabulated in detail. Comparison is also made with foundation made in 1893, so as to bring out the relative improvement that has taken place. In conclusion the author says:

"(1) In all cases except the Van Deusen there seems to have been an improvement in the foundation over that used in 1893, and in the case of the Van Deusen it is to be noted that the bees accepted only the septum, which was shown by their removing the cell walls and building instead more or less regular drone cells.

"(2) Most remarkable is the improvement in the foundations made by Root and by the Dadants in so far as the lightness of the septa is concerned. By a comparison with the measurements of the septa of the unworked foundation, it was shown that the foundation was so skillfully made that the bees either pared down the septa or else manipulated the entire wax of the septa, using for them only what was necessary, so that the resulting comb did not suffer at all so far as thinness was concerned in comparison with the natural comb.

"(3) The same thinning process is very apparent in the drawing out of the Hunt foundation.

"(4) In the case of the Van Deusen and generally in a greater or less degree in the case of that made on the Given press the process has been changed to a thickening one.

"(5) In point of thinness of base of the comb produced, the foundations stand in the following order: The Dadant first, then in their order the Root, the Given, the Hunt, and the Van Deusen.

"(6) The comparison by weighing places them in substantially the same order. Where there is a variance it is reasonably accounted for by the difference in the size of the cells. Thus the Van Deusen, had it carried the amount of cell walls that would have been necessary for worker comb, would evidently have been of considerably greater weight."

An experiment with foul brood.—An attempt was made to solve the important practical question as to whether the germs of foul brood may be transmitted by the use of foundation made from infected wax. Experiments were begun in 1891 to determine whether the germs are killed by the temperature to which wax is usually raised in making the foundation, but not completed until 1894. In these experiments the wax was subjected to a temperature of 175°. No sign of foul brood was found on comb made from it until October 8, when a single cell containing what was apparently foul-brood matter was found in each of the hives to which the foundation had been supplied.

Appended to this account is a paragraph stating that in a colony showing unmistakable signs of foul brood in 1892 and since then kept under observation for this point, there was some slight evidence of the disease in August, but that by October it had all disappeared.

Feeding back.—Experiments made to determine the value of this process resulted very advantageously. In the experiments, honey diluted with 15 to 20 per cent of hot water was used and placed in milk pans on top of the sections, protected by an empty hive or other bee-proof rim. To give the bee a foothold, strips of clean cloth were employed, one end being dipped in the honey and the other allowed to reach to the tops of the sections.

The process is said to lessen the labor of extracting, since incomplete combs are filled and hence evened up. The colonies are improved both in numerical strength and in the proportion of young bees, a point of great importance in successful wintering. Further, over and above all drawbacks, there is said to be a positive gain in profit amounting to from 30 to 60 per cent, according to the degree of advancement to which the sections have been carried by the bees when the process is begun.

Prevention and management of swarming.—Under this head the author considers the 2 methods for prevention of swarming, namely, clipping the wings of the queen, and the use of traps. It is recommended to keep the traps on the hives until the danger of after-swarming has passed, which may be from 10 to 16 days. Then they should be removed to allow the young queen to take her flight, care being exercised that she does not get caught in the trap and perish there.

Experiments were made with Conser's hive and with Langdon's non-swarming attachment, but with unfavorable results. The season was somewhat unfavorable to swarming, and continued tests during several favorable seasons are considered necessary for conclusive results.

A note is added relative to experiments with 5 banded bees, which, of all the bees in a large apiary, showed the greatest disposition to rob.

Wintering experiments.—A description is given of the cellar used for wintering and the method of packing, along with remarks on the cause of dysentery. This is attributed to the bees being so closely confined that they are obliged to retain their feces. When the temperature and other conditions are such that they can go outside of the hives there is little evidence of the trouble.

As to time for placing in the cellar, the earlier part of November is preferred to the latter part. Summarizing briefly the results of experiments with 37 colonies, it is stated that "the average strength of the entire lot of 37 colonies was 6.59, average fall weight 53.52 lbs., average spring weight 42.20 lbs., average consumption 11.32 lbs., average consumption per unit of strength 1.72 lbs."

The experiments in spring packing resulted favorably to the process and showed that there was an increase in weight and the production of a large amount of brood.

In conclusion the economy of the hive is briefly treated, including the building of the comb, the rearing of young bees and of queens, and the laying of eggs.

Report of the entomologist, J. B. SMITH (*New Jersey Stas. Rpt. 1895, pp. 365–526, figs. 86*).—Besides a general review of the season, miscellaneous information is given on a number of different insects.

General review of the season (pp. 365–412).—There are treated, in a general way, cutworms, the sinuate pear borer, pear midge, bagworm, potato beetle, San José scale and other scales, elm leaf beetle, maple pseudococcus, the fall webworm, the fruit bark beetle, plant lice, potato stalk borer, cranberry insect, wireworm, and white grubs, and a section is added on the subject of insecticides. In the latter section the author summarizes the results of his experience, and among other things states that arsenate of lead must be used in larger proportion than other arsenical poisons, but that when used at the rate of 2 lbs. to 100 gal. of water it may be employed with entire safety to the plant, and as an insecticide will then equal Paris green, or London purple used at the rate of 1 lb. to 125 gal. Although thus used it is rather more expensive than Paris green, it has some advantages over the latter. Potato Bug Exterminator Compound was not found to fulfill the claims made for it. Fir Tree Oil Soap was found inefficient in killing scales in any strength in which it could be used.

Referring to the sinuate pear borer, the author says that instead of Raupenleim or Dendrolene, canvas or some equivalent fabric which the insects can not eat through may be used on the trunks and larger branches of trees. Heavy paper wrapped about the tree, he thinks, would probably serve the purpose equally well, or the trunks of the trees might be smeared with some material that would harden and form a coat impenetrable to the insects.

As an insecticide for scale insects he prefers whale-oil soap to fish-oil soap as being considerably cheaper. As a remedy for the elm leaf

beetle, arsenate of lead used at the rate of 15 oz. to 80 gal. of water, to which 2 qt. of thick molasses was added, was successfully used. As soon as the beetles are noticed feeding upon the leaves, and before they have had a chance to oviposit, the trees should receive their first spraying. Later, when the leaves have unfolded, they should be subjected to a second spraying. If the work is thoroughly done, all the beetles will be killed, but in order to insure success the use of a very strong solution of arsenate of lead is recommended, say 1 lb. to 75 gal. of water. A synopsis of the reports received from different parts of the State relative to injurious insects forms a kind of appendix to the first part of the report.

Relation of insects to fruits (pp. 413-452).—The second part of the report is comprised under this head and discusses, in a more or less general way, the subject of pollination, and is based largely upon the author's own observations, which show in certain cases there is need, at least in some portions of the State, of systematic bee keeping.

The details of the external anatomy of insects, such as the tongues and hairs of moths, bees, flies, etc., are discussed and figured as they appear beneath the microscope.

Miscellaneous notes (pp. 452–526).—In this part of the report, Bulletin No. 111 (E. S. R., 7, p. 515) on Raupenleim or Dendrolene is reproduced in full, as is also Bulletin 110 (E. S. R., 7, p. 514) on the Hessian fly, and the life history, habits, and appropriate remedies for the following insects are discussed with some detail: The Colorado potato beetle (*Doryphora 10-lineata*), the fall webworm (*Hyphantria cunea*), the maple pseudococcus (*Pseudococcus aceris*), the hickory bark borer (*Scolytus 4-spinosus*), saddle back caterpillar (*Empretia stimulea*), the melon louse (*Aphis gossypii*), American procris (*Harrissina americana*), the cabbage maggot (*Phorbia brassicæ*), white grubs (*Lacnosterna* sp.), the fig eater (*Allorhina nitida*), and the Hessian fly (*Cecidomyia destructor*). In preparing these accounts former bulletins of the station and the work of others have been used.

Relative to remedies to be used against the potato bug, the author strongly advises the killing off of the early beetles and the destruction of all such weeds as "horse nettle" and "jimson," adding that, if this be done, the beetle will be so rare within a few years that injuries from it will be insignificant.

With reference to the hickory bark borer, he points out that healthy and vigorous trees are rarely injured, but as soon as the trees are weakened from any cause they are attacked with a readiness that varies directly as the numbers of the insects. If the latter are in sufficient numbers to attack the entire circumference of the trunk of a tree, it is soon girdled and death follows.

The simplest remedy to be used against the insect is poisoned whitewash applied early in the season, and, if possible, kept intact throughout the year. This will discourage the beetles when looking for places to oviposit, and will undoubtedly kill all that may attempt to gnaw

through the poisoned layer to the bark. The amount of Paris green used is believed to be immaterial, but it may be stated that 1 oz. to 3 or 4 gal. of whitewash will be amply sufficient.

Flesh wounds produced by the hairs of the saddle back caterpillars are discussed, and the very good advice given not to rub the affected part; but, since the poisoning is due to an acid, some alkali like ammonia or a strong solution of common washing soda, or even strong brine or a preparation known as "Phenol sodique," may be applied.

As a remedy against the melon plant louse, bisulphid of carbon is recommended, a small amount being placed near the young plant and both covered. A strong whale-oil soap mixture is also recommended. Relative to the cabbage maggot, the author recommends the treatment prescribed in New York Cornell Station Bulletin 78 (E. S. R., 6, pp. 911–925).

Report of the consulting entomologist, G. C. DAVIS (*Michigan Sta. Rpt. 1895, pp. 172–179*).—The author considers here the chinch bug (*Blissus leucopterus*), willow leaf beetle (*Lina lapponica*), climbing cutworms (*Mamestra subjuncta*), June beetles (*Lachnosterna tristis* and *L. fusca*), shot hole peach tree borers (*Monarthrum fasciatum*, *M. mali*, and *Xyleborus fuscatus*), blister beetles (*Macrobasis unicolor* and *Epicauta pennsylvanicus*), scale insects, *Plusia simplex*, and locusts. Relative to the last he states that numerous reports were received from near Marquette and Ishpeming to the effect that locusts had appeared in such numbers that trains were often impeded in their movements by swarms of hoppers on the rails. The greater number of the insects were the common species, *Camnula pellucida*, *Melanoplus atlantis*, *M. bivattatus*, and *M. femur-rubrum*.

Relative to the chinch bug, it is stated that they have made greater inroads into the State than ever before, and that large numbers of them have been found on the shore of the lake, over which they were probably blown by the wind.

Experiments were made against the climbing cutworm with Raupenleim and various other forms of bands, as well as with bran poisoned with Paris green and sprinkled about the bases of the trees. The latter method resulted in killing in some cases 90 per cent of the insects that were unable to pass over the bands and up the trees. Of all the bands tried the kind made from tin was found most inefficient.

The borer *Xyleborus fuscatus* seems to be described for the first time as affecting orchard fruits, it heretofore having been known as affecting only oak and hickory.

Against the blister beetles the author recommends the use of a spray of kerosene as soon as the insects appear. Lettuce affected with *Plusia simplex* he thinks best treated with hot water at a temperature of 130 to 160°.

Report of the entomologist and botanist of the Canada Experimental Farms, J. FLETCHER (*Canada Exptl. Farms Rpt. 1895, pp. 135–166, figs. 14*).—In this report there are mentioned, more or less

in detail, a number of the more common injurious insects, with the proper remedies against them. The general subject of spraying is also discussed.

The following insects are treated: The bee moth (*Galleria mellonella*), the grain plant louse (*Siphonophora avenæ*), the glossy cutworm (*Hadena devastatrix*), the jointworm (*Isosoma hordei*), grasshoppers (Acrydiidæ), the cottony grass scale (*Eriopeltis festucæ*), the scurfy bark louse (*Chionaspis furfurus*), apple leaf sewer (*Phoxopteris nubeculana*), strawberry slug (*Harpiphorus maculatus*), raspberry root borer (*Bembecia marginata*), the click beetle (*Corymbites caricinus*), the cankerworm (*Anisopteryx vernata* and *A. pometaria*), cigar case bearer (*Coleophora fletcherella*), peach bark borer (*Phlœotribus liminaris*), black peach aphis (*Aphis persicæ-niger*), New York plum scale (*Lecanium cerasifex*), the parasites (*Pachyneuron altiscuta* and *Eunotus lividus*), the ladybird (*Hyperaspis signata*), pear leaf blister mite (*Phytoptus pyri*), apple aphis (*Aphis mali*), woolly aphis (*Schizoneura lanigera*), carpet beetle or buffalo moth (*Anthrenus scrophulariæ*), and the pea weevil (*Bruchus pisi*).

The Australian sugar-cane pest (Lepidiota squamulata), H. TRYON (*Queensland Dept. Agr. Rpt. 1895–'96, pp. 56*).—This gives a very full account of this beetle, its habits, and the means for checking it. After a historical introduction, and a full description of the insect in its different stages from the egg to the adult, and a brief description of the nature of the injury done by it, the author proceeds to give an account of its habits.

The grubs are found in enormous numbers, sometimes as many as 26,000 to 30,000 per acre. The opening up of lands to cultivation has greatly facilitated their increase. Under natural conditions they are found mostly in forest lands, as is shown by the fact that they occur in the first plant crop grown on new scrub land only in exceptional cases. The grubs bore several feet into the ground, especially during dry weather, and this fact accounts for their apparent absence from fields, and for their sudden appearance in great numbers and in a nearly full grown condition. They migrate laterally also, but as they will not pass through the face of a cutting, a trench 3 ft. deep forms a sufficient barrier. When this method is practicable they may be drowned by flooding a field. Other remedies recommended for destroying the larvæ are hand picking, the planting of trap crops, and grubbing these out from time to time; the use of bisulphid of carbon, and of kerosene emulsion, common salt, kainit, and sulphate of potash.

The adult state, the author thinks, in opposition to general opinion, is reached within a year from the laying of the egg. This assertion is based upon field observations and not upon experimentation. When mature, the insect feeds upon a large number of plants, embraced chiefly within the orders Sterculiaceæ, Leguminosæ, Euphorbiaceæ, and Urticaceæ. Plants of the last two groups are especially preferred.

A long descriptive list of natural enemies is given, embracing several mammals, hawks, crows, shrikes, plovers, tachnid flies, mites, and fungi.

The growing of decoy plants, or the extirpation of wild food plants, hand picking, light-traps, encouraging natural enemies, proper legislation, and the offering of bounties are recommended or discussed as remedies or preventives. The introduction of insectivorous animals, especially the mole, the author cautiously considers. He seems inclined to favor such a course, although he does not care to take the responsibility of recommending it.

Fruit tree borers, A. CRAW (*California Fruit Grower, 20* (*1897*), *No. 1, p. 4*).—A popular account is here given of the various common fruit borers of California, with notes as to remedies and preventives. The peach tree borer (*Sannina exitiosa*) may be killed and removed by means of a wire and the wound in the tree coated with pine tar. Where the tree has been badly affected, judicious pruning may restore the tree to its normal condition. Carbolic acid and Dendrolene are not to be recommended for use in the warm climate of California.

The currant bush pest (*Ægeria tipuliformis*), in the adult state, may be driven away by the use of lime and sulphur. The larva should be destroyed by grubbing out and burning the bush eggs. The flat-headed apple tree borer (*Chrysobothris femorata*) may be destroyed by means of kerosene emulsion injected into its holes with a syringe.

Locust destruction in Natal (*Agl. Jour. Cape of Good Hope, 10* (*1897*), *No. 3, pp. 65, 66*).—A brief review of the report of the commissioner of agriculture for Natal for 1896. It was reported that the egg deposit of the locust was less for this than the former year and that a large percentage of eggs were destroyed by maggots, ants, etc. It is said that however numerous the "hoppers" may be they can be destroyed in a few days by the judicious use of an arsenical mixture applied on bait. The mixture recommended consists of 1 lb. of arsenic, 1 lb. of caustic soda, and 4 gal. of boiling water. To every ½ gal. of this are added 4 gal. of hot or cold water and 10 lbs. of brown sugar.

Report on the phylloxera in Hungary during the years 1891–'93 (*Jelentés a Filloxeraügy Állásáról Magyarországban az 1891–'93 ik években, Budapest, Hungary, 1895, pp. 57*).—During this time it was found that the phylloxera had increased so that at the end of 1893 there were in the entire territory of Hungary 2,727 parishes infected. Workmen were employed at the expense of the Government to destroy the pest, and the establishment of nurseries of American vines was encouraged. A large amount of foreign stock was imported, and roots, cuttings, and buds distributed gratuitously or sold at a low price. In the southern portion of the country some 40,000 acres of sand land were parceled out and sold at a very reduced price to small vineyard holders. Some idea of the magnitude of the insect pestilence may be obtained from the fact that during the 3 years 5,370 metric quintals (each 220 lbs.) of carbon bisulphid (the entire production of this substance in Hungary) and over 4,900 quintals which were imported were used against the insect.

Eel worm (Tylenchus devastatrix), E. A. ORMEROD (*Report of observations of injurious insects and common farm pests during the year 1896; 20th rpt. London: Simpkin, Marshall, Hamilton, Kent & Co., 1897, pp. 44–52, 107–116, figs. 4, pl. 1*).—This worm, producing in oats what is known as "tulip root" or "segging," and in clover as the "stem sickness," and in onions as "onion sickness," is described at some length.

In onions it occurs in the bulbs and in the stalk just above them, causing them to rot away. When once in the land it is very difficult to eradicate, and may be easily carried from place to place on cart wheels, etc. Care should be taken not to sow infested seed, and thus allow it to gain entrance into a field. Onion seed may be steeped in a dilute solution of sulphuric acid (1 pint to 150 qts. of water) before sowing. The field crops may be covered with a dressing of sulphate of potash, of iron, or of ammonium, at the rate of from 100 or 200 lbs. per acre, or as much as 300 lbs. per acre in the case of sulphate of potash. Mixtures of these may be applied to advantage.

To destroy the worms in the land, very deep plowing should be resorted to.

Injurious insects, E. A. ORMEROD (*Report of observations of injurious insects and common farm pests during the year 1896; 20th rpt. London: Simpkin, Marshall, Hamilton, Kent & Co., 1897, pp. 160, figs. 35*).—After a brief discussion of the meteorological conditions of the year, as compared with those of the preceding year, and giving a list of the insects and affected plants concerning which inquiries were received during the year, the author proceeds to discuss in detail the common pests of the orchard, house, and garden. American authorities are freely quoted and sometimes details from letters are given. The customary reliable remedies and preventives are recommended. A variation from the usual sticky band for preventing larvæ from crawling up a tree may be noted. It consists of twisted ropes of straw covered with wagon grease and placed about the base of the trees.

Caddis fly larvæ are noted as destructive to water cresses and the remedy recommended of flooding the beds and dragging the plants with a weighted log, which causes the worms to rise to the surface of the water, where they float downstream with the current. In an appended note wagon grease, if it does not contain irritating matter, is recommended as a cheap and reliable remedy for warbles, especially when a little sulphur is added to it. Mercurial ointment is not thought an advisable remedy, since it is apt to be used carelessly. It should be applied in minute quantities, and only once as a mere touch to the warble.

The pests treated here are as follows: The codling moth (*Carpocapsa pomonella*), sawfly (*Hoplocampa testudinea*), asparagus beetle (*Crioceris asparagi*), beet carrion beetle (*Silpha opaca*), leather and bone beetle (*Dermestes vulpinus*), cabbage butterflies (*Pieris brassicæ* and *P. rapæ*), the German cockroach (*Phyllodromia germanica*), the corn, grass, and

onion pests (*Phylopertha horticola*, *Melolontha vulgaris*, *Hepialus lupulinus*, and *Tylenchus devastatrix*), the currant moth (*Incurvaria capitella*), deer botfly (*Cephenomyia rufibarbis*), deer forest fly (*Lipoptera cervi*), common earwig (*Forficula auricularia*), house flies (*Musca domestica*), leafage caterpillars (*Tortrix viridana*, *Emphytus* sp., *Hybernia defoliaria*, *Cheimatobia brumata*), mill moth (*Ephestia kuehniella*), pear gnat midge (*Diplosis pyrivora*), pear lyda (*Pamphilius flaviventris*), pear and cherry sawfly (*Eriocampa limacina*), leaf weevil (*Phyllobius oblongus*), pine beetle (*Hylurgus piniperda*), hart and dart moth (*Agrotis exclamationis*), turnip moth (*Agrotis segetum*), turnip gnat midge (*Cecidomyia brassicæ*), and caddis worms.

Insects, J. T. STINSON (*Arkansas Sta. Bul. 43, pp. 105–117, figs. 9*).—This treats of the cankerworms (*Paleacrita vernata* and *Anisopteryx pometaria*), the grape cane borer (*Amphicerus bicaudatus*), the grape leaf folder (*Desmia maculalis*), the grapevine fidia (*Fidia viticida*) and the bagworm (*Thyridopteryx ephemeræformis*). With the exception of notes upon the bagworm, the article is almost entirely a compilation descriptive of the insects and their life histories. The bagworm is reported as doing much damage. Spraying with London purple or Paris green is recommended; also the addition of a little lime to the arsenite spraying mixtures.

On the parasites of the diseased and healthy silkworm; contribution to the study of flacherie, grasserie, and pebrine, I. KRASILSHTSHIK (*Memoirs Soc. Zool. France, 9 (1896), V, pp. 513–522*).—In this contribution, after a few critical remarks, the author proceeds to point out the differences between *Streptococcus pastorianus* and *Staphylococcus insectorum* and to describe *Bacillus hofmanni*, *Micrococcus lardarius*, and a new property of the corpuscles of pebrine.

Streptococcus pastorianus differs materially from *Staphylococcus insectorum* in its manner of multiplication and in the appearance of its cultures and in the fact that it liquefies gelatin. During multiplication there is often produced a diplococcus and each of these elongates, finally producing a small chain of cocci, each of which ultimately divides in the same manner.

Staphylococcus insectorum increases in size while maintaining its spherical form until finally a partition appears, dividing it into hemispheres, without one separating from the other. Sometimes a partition perpendicular to the first also appears, dividing the entire spherule into four cocci.

Experimentation determined that *Streptococcus pastorianus* is the true cause of flacherie. It first gains entrance into the intestine and then passes through the walls of this to the blood, in which it forms pure cultures. It is followed by *Staphylococcus insectorum* and by *Bacillus hofmanni*, both of which are found in the intestine of the healthy and normal animal.

Like *Streptococcus pastorianus*, the micrococcus of grasserie (*Micrococcus lardarius*) liquefies gelatin, and during development sometimes

appears in the form of a diplococcus. It differs, however, in being very much smaller—0.5 to 0.6 μ as compared with 1 μ—and in the young colonies having a finer granulation.

In experiments with live worms fed with a mixture of *Streptococcus pastorianus* and *Micrococcus lardarius*, the symptoms of both flacherie and grasserie were produced. This result is compared with the fact that in the grayish diseased animals often met with *Streptococcus pastorianus* and *Micrococcus lardarius* are always found.

A simple experiment is recorded showing how the virulence of pebrine may be increased and how flacherie and grasserie might be disseminated among insects. Diseased moths were ground up in a mortar with a little water. Into this mixture pieces of bread were dipped and then fed to the common sparrow (*Fringilla domestica*). Later the excrement of the bird was smeared on leaves upon which silkworms were feeding. The latter soon developed the characteristic symptoms of pebrine. If the excrement became dry no such result followed, but the other diseases, flacherie and grasserie, appeared, nevertheless.

The Coleoptera of Canada, XXI: The Chrysomelidæ of Ontario and Quebec, Tribe X, Hispini, H. F. WICKHAM (*Canadian Ent., 29 (1897), No. 3, pp. 60–63*).

Intelligence shown by caterpillars in placing their cocoons, W. T. DAVIS (*Jour. New York Ent. Soc., 5 (1897), No. 1, pp. 42–44*).—The formation of their cocoons by Cecropia and Telea larvæ near the ends of small twigs protects them from woodpeckers, etc.

Observations on the habits of two hymenopterous diggers, A. PUTON (*Rev. d'Ent., 15 (1896), No. 10, pp. 234, 235*).—Notes on *Grotes exiguus* and *Ceratocolus subterraneus*.

On the color and color patterns of moths and butterflies, A. G. MAYER (*Proc. Boston Soc. Nat. Hist., 27 (1897), No. 14, pp. 243–330, pls. 10*).

Morphology of the appendices of the orthopteran midgut, L. BORDAS (*Compt. Rend., 124 (1897), No. 7, pp. 376–378*).

The hair-forming dermal glands of larvæ, E. HOLMGREN (*Ent. Tidskr., 17 (1896), No. 2–3, pp. 81–85, pl. 1*).

On the preparation of butterfly larvæ, J. PEYRON (*Ent. Tidskr., 17 (1896), No. 2–3, pp. 209–215*).

Myrmecological notes, G. ADLERZ (*Ent. Tidskr., 17 (1896), No. 2–3, pp. 129–141*).

Physopod notes, F. TRYBOM (*Ent. Tidskr., 17 (1896), No. 2–3, pp. 87–104, figs. 4*).—This paper discusses the species of Thrips living on willow leaves, *Thrips salicaris*, and its relationships, and an organ found on the leg of Phlœothrips which recalls the auditory organ of Locusta. The organ occurs on all three pairs of femora.

The larvæ of British butterflies and moths, W. BUCKLER, edited by G. T. Porrit (*London: Royal Society, 1897, Vol. VII, pp. 176, pls. 22*).

New forms of Osmia from New Mexico, T. D. A. COCKERELL (*Canadian Ent., 29 (1897), No. 3, pp. 65, 66*).—The new species *Osmia prunorum*, *O. phenax*, and *O. cerasi* are described.

A remarkable sembling habit of Coccinella transversoguttata, C. V. PIPER (*Ent. News, 8 (1897), No. 3, pp. 49–51*).—The beetles were found several times in large swarms on Mt. Moscow, Idaho. An endeavor is made to account for the phenomena by supposing these beetles to have been brought there by air currents. But this explanation does not satisfy the author.

Further notes on Augochlora, T. D. A. COCKERELL (*Canadian Ent., 29 (1897), No. 3, pp. 68–70*).—New species, *Augochlora robertsoni* and *A. townsendi*.

Notes on Coccidæ from the Royal Gardens, Kew, E. E. GREEN, with additions by R. Newstead (*Ent. Monthly Mag., ser. 2, 8 (1897), Mar., p. 68*).

On the phylogeny and evolution of the Lepidoptera from a pupal and oval standpoint, J. A. CHAPMAN (*Trans. Ent. Soc. London, 1896, No. 4, pp. 567–587*).

The apiary, J. FLETCHER (*Canada Exptl. Farms Rpt. 1895, pp. 167–177, fig. 1*).—This report is made up mostly of the reports of J. Fixter and F. T. Shutt. Experiments in wintering with buckwheat and with different brands of foundation are detailed. The bee moth (*Galleria mellonella*) is treated.

Silk-producing Lepidoptera: List of North American species, A. WAILLY (*Ent., 30 (1897), No. 405, pp. 39–44*).

Immunity from mosquito bites: Periodicity in the phenomena which follow a bite, D. WILLIAMS (*Nature, 55 (1897), No. 1427, p. 415*).

Golden tailed moth (*Gardening, 19 (1897), No. 940, p. 18, figs. 2*).—Notes on *Porthesia auriflua*.

On the larvæ of certain sawflies (Tenthredinidæ), H. G. DYAR (*Jour. New York Ent. Soc., 5 (1897), No. 1, pp. 18–30*).

The crinkled flannel moth (Megalopyge orispata Pack), M. V. SLINGERLAND (*Canadian Ent., 29 (1897), No. 1, pp. 1, 2*).

Biological notes on certain Iowa insects, H. OSBORN and C. W. MALLY (*Proc. Iowa Acad. Sci., Vol. III, 1895 (1896), pp. 203–213*).—Ground cherry seed moth (*Gelechia* sp.), *Epicatrus imbricatus, Baris confinis*, and *Chronomus* sp.

The mole cricket, J. RITZEMA BOS (*Tijdschr. Plantenzeikt, 2 (1896), pp. 4, 5, fig. 1*).—Brief notes on *Gryllotalpa vulgaris*.

Bees vs. grapes, J. TROOP (*Indiana Sta. Rpt. 1896, pp. 47, 48*).—This subject has been previously noted (E. S. R., 8, p. 601).

Report of the entomologist of the Hawaiian Government, A. KOEBELE (*Hawaiian Planters' Monthly, 16 (1897), No. 2, pp. 65–85*).—Scale insects and their imported insect enemies. The Japanese *Adoretus umbrosus* introduced into Hawaii.

Reports of observations of injurious insects and common farm pests during the year 1896, with methods of prevention and remedy, E. A. ORMEROD (*20th Rpt., pp. 160, figs. 35*).

Injurious insects and fungi (*Jour. Bd. Agr. London, 3 (1897), No. 4, pp. 390–392*).—The carrot fly (*Psila rosæ*), its life history, and damages are discussed. Spraying with paraffin oil emulsion, made of 1 lb. of soft soap, 10 gal. of water, and 1 gal. of paraffin oil, is recommended as a remedy. Putting wood ashes, sawdust, and sand or peat moss, triturated and saturated with paraffin oil, into the drill with the seed is also recommended. Sand or ashes scattered over the plants at singling time may keep the flies from them.

Description of the most noxious insects in the forests of Russia (*St. Petersburg (Russian), 1893, pp. 24, pls. 24*).—Brief descriptions of Melolontha and Polyphylla, *Zeuzera pyrina, Hilesinus piniperda, Ocneria dispar, O. monacha, Gastropacha pini, Panolis piniperda, Fidonia piniaria, Lophyrus pini, Tomicus typographus*, and *T. chalcographus* are given. Each is illustrated by a colored plate.

Insects of the clover field, C. F. WHEELER and G. C. DAVIS (*Michigan Sta. Rpt. 1895, pp. 377–400*).—A reprint of Bulletin 116 of the station (E. S. R., 6, p. 648).

Pests of the orchard and garden, L. R. TAFT and G. C. DAVIS (*Michigan Sta. Rpt. 1895, pp. 549–623*).—A reprint of Bulletin 121 of the station (E. S. R., 7, p. 306).

The pear agrilus, GITTON (*Rev. Hort., 69 (1897), No. 6, pp. 133, 134*).—Notes on *Agrilus sinuatus*.

Garden pests (*Gardening, 19 (1897), No. 941, p. 28, fig. 1*).—Notes are given on the peach aphis (*Aphis amygdali*), with suggestions for its destruction.

Lucern pest, A. MOLINEUX (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 807–809*).—This is a species of Smynthurus.

Address on the San José scale, F. M. WEBSTER (*Proc. 52d Ann. State Agl. Convention, Columbus, Ohio, Jan. 14, 1897*).

A new enemy of the fir, HORVATH (*Ztschr. Ungar. Landesforst.; abs. in Centbl. gesammte. Forstwesen, 23 (1897), No. 3, pp. 133-137*).—The insect is *Steganoptycha abiegana.*

Phytoptus laricis, n. sp., a new parasite on the larch (Larix europea), C. VON TUBEUF (*Forstl. naturw. Ztschr., 6 (1897), No. 3, pp. 120-124, figs. 3*).—A new mite producing galls. The differences between the galls and those produced by the larch gallfly, *Cecidomyia kellneri,* are pointed out.

The pests of the orchard and garden, L. R. TAFT and G. C. DAVIS (*Michigan Sta. Rpt. 1895, pp. 549-623, figs. 69, pl. 1*).—A reprint of Bulletin 121 of the station (E. S. R., 7, p. 310).

Cankerworms in the apple orchard (*Michigan Sta. Rpt. 1895, p. 669*).—A reprint of Press Bulletin 8 of the station, giving popular notes upon this pest.

Insects of the clover field, C. F. WHEELER and G. C. DAVIS (*Michigan Sta. Rpt. 1895, pp. 377-400, figs. 11, map 1*).—A reprint of Bulletin 116 of the station (E. S. R., 6, p. 648).

New facts about the codling moth, M. V. SLINGERLAND (*Garden and Forest, 10 (1897), No. 468, pp. 58, 59*).—Report of the meeting of the Western New York Horticultural Society.

The Mexican cotton boll weevil, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circ. 18, pp. 8, figs. 5*).—This is a revised reprint of Circular 14. A new map illustrates the distribution of the pest during 1895. An edition in the Spanish language was also printed.

The grape louse and its destruction: The grape louse invasion in Würtemberg and its destruction (*Würtemberg Wochenbl. landw., 1897, Nos. 7, pp. 94-96; 8, pp. 109, 110*).—A table is given showing the damages done from 1876 to the present. Other tables bring out the extent of the vineyard surface infected and the damage done, etc.

Note on locusts as propagators of foot and mouth disease, L. KANNEMEYER (*Trans. South Africa Phil. Soc., 18 (1896), No. 2, pp. 84, 85*).—Locusts coming from infested localities were covered with a tenacious mucus, which adheres to the herbage.

The parasitic diseases of poultry, F. V. THEOBALD (*London: Gurney & Jackson, 1896, pp. 120, figs. 23*).—A manual for the poultry keeper, describing briefly the common vegetable and animal parasites of poultry, together with the symptoms produced by and the remedies to be used against them.

Beet nematodes, J. VANHA and J. STOCKLASA (*Die Rübennematoden. Berlin: P. Parey, 1896*).—Studies of Heterodera, Dorylaimus, and Tylenchus, with a supplement on the Enchytræidæ.

Recommendations as to State and National legislation relating to insect pests and plant diseases, W. B. ALWOOD (*pp. 8*).—This is a report of the committee of the national convention to consider this subject held at Washington, District of Columbia, March 5 and 6, 1897, and contains the text of the bill that was recommended.

Arsenate of lead, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1895, p. 220*).—Note on the composition and use of this substance as an insecticide.

Dendrolene as an insecticide, J. TROOP (*Indiana Sta. Rpt. 1896, p. 46*).—The substance of this article has already appeared (E. S. R., 8, p. 418).

Spraying fruit trees with Paris green as a means against larvæ, W. M. SCHÖYEN (*Ent. Tidskr., 17 (1896), No. 2-3, pp. 216-220*).

On spraying, S. LAMPA (*Ent. Tidskr., 17 (1896), No. 2-3, pp. 172-175*).—Several pieces of spraying apparatus are described.

Calcium carbid for the destruction of phylloxera (*Allg. Wien. Ztg., 1896, No. 45, pp. 444, 445*).

New observations on the hymenopterous parasites of larvæ, P. CHRISTIEN (*Bul. Soc. Ent. France, 1896, Dec. 9, pp. 410-412*).—Food habits of *Eumenes pomiformis, E. arbustorum, Ammophila sabulosa,* and *Odynerus spivicorrus.* A few parasites are mentioned.

The introduction of beneficial insects into the Hawaiian Islands, R. C. L. PERKINS (*Nature, 55 (1897), No. 1430, pp. 499, 500; abs. in Rev. Scient., ser. 4, 7 (1897), No. 14, p. 437*).—According to this note the introduction of *Vedalia cardinalis* and *Coccinella repanda* into the Sandwich Islands has been entirely successful.

On the relations of Antennophorus uhlmanni to Lasius mixtus, C. JANET (*Compt. Rend., 124 (1897), No. 11, pp. 583, 584, fig. 1*).—The mite is described and figured as being carried about and fed by worker ants.

Combine against insect pests, etc. (*Amer. Gard., 18 (1897), No. 116, p. 172*).—At the convention held at Washington for considering and recommending Federal and State legislation to prevent the introduction of insects and fungi it was decided, after some discussion, to recommend an act, entitled "An act to provide for the inspection of trees, plants, shrubs, roots, buds, pips, scions, grafts, or nursery stock imported into the United States which become the subject of interstate commerce." According to this act, the Secretary of Agriculture is empowered to place, at the expense of the owner, any or all of the above-mentioned articles in quarantine and have them inspected. Appeals may be taken from the inspector to the Secretary of Agriculture. For goods not found infected a certificate is to be given; if they have been inspected abroad they may pass without reinspection.

Preliminary handbook of the Coleoptera of northeastern America, W. BEUTENMULLER (*Jour. New York Ent. Soc., 5 (1897), No. 1, pp. 36–40*).

FOODS—ANIMAL PRODUCTION.

Concerning wheat and its mill products, G. L. TELLER, (*Arkansas Sta. Bul. 42, pp. 61–73*).—The author reports 3 milling tests made with winter wheat grown in Arkansas. The first test was made with a long process roller mill (7 breaks), grinding about 40 bu. per hour. The other tests were made with a 4-break mill, grinding about 7 bu. per hour and using the plansifter method of bolting. The amount and composition of the flour and other milling products from these 3 tests are given in tabular form.

The author discusses the classification and composition of flours. The laxative effect of coarser flours has been attributed to the percentage of bran which they contain. The author calls attention to the fact that the low-grade flours do not possess a high content of crude fiber and believes "that the laxative effect of bran and low-grade flours is due rather to the kind of proteids which they contain than to the mechanical action of their branny particles."

"This laxative action of bran and low-grade flours may be made to serve a useful purpose as food for some, and finely ground whole wheat meal, or graham flour, may be especially useful for that purpose and for giving a change of food as well as for supplying a larger proportion of bone-forming material, which it contains as ash. Where bread forms a very large proportion of the food this special value of the ash constituents, especially for growing children, may be great. Where considerable quantities of other foods, such as vegetables, milk, and meat, are consumed, the bone material will be supplied in sufficient quantities even when the very whitest qualities of flour are used. Among other foods, peas, beans, and oatmeal are especially rich in bone-forming material."

The fertilizing constituents in the wheat and the different milling products were determined.

The loss in weight of wheat during sprouting was also investigated.

The wheat was wet and at the close of the sprouting period was dried until it had the same water content as before wetting. The loss in weight for different periods is shown in the following table:

Loss in weight of wheat sprouting for different lengths of time.

	Per cent.
24 hours	1.5
48 hours	2.5
72 hours	5.9
99 hours	6.7
120 hours	10.1
144 hours	11.8

"Aside from the loss in weight which occurs in the sprouting of wheat, marked chemical changes are brought about which decrease greatly the value of the article for bread-baking purposes, and probably, also, as a food for stock.

"The importance of protecting the wheat by proper stacking or storing in barns as soon as possible after it is ripe and dry is great. The expense of stacking will often be small as compared with losses which may occur by attempting to wait till a machine can be procured for the purpose of thrashing direct from the shock."

Composition of the ash of wheat and its mill products, G. L. TELLER (*Arkansas Sta. Bul. 42, pp. 70–72, 75–80*).—Complete ash analyses were made of the whole wheat, the flour, and other milling products from one of the milling tests mentioned above. The results are shown in the following table:

Ash of winter wheat and its milling products.

	Patent flour.	Straight flour.	Low grade.	Dust room.	Ship stuff.	Bran.	Wheat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ash	0.31	0.40	0.70	2.50	3.08	5.25	1.62
Composition of ash:							
Silica	2.33	1.28	0.50	1.34	0.49	0.97	1.04
Aluminum oxid	.41	.15	.12	.04	.18	.07	.11
Ferric oxid	.47	.26	.25	.30	.37	.27	.27
Potassium oxid	38.50	36.31	32.27	30.85	28.03	28.19	29.70
Calcium oxid	5.59	5.65	4.51	3.53	2.80	2.50	3.10
Magnesium oxid	4.39	6.44	9.33	12.90	15.27	14.76	13.23
Phosphoric acid	48.05	49.32	53.10	49.94	54.62	52.81	52.14
Sulphur trioxid	.16	.52		.58		.10	.22
Chlorin						.01	.01
Zinc oxid		.04		.46	.36	.27	.24
Sum	99.90	99.97	100.08	99.94	100.12	99.95	100.06

Sodium oxid was not found in the ash in any case.

The presence of alumina in wheat has been attributed to the wearing down of the millstones.

"This could not have been a source of the material in these mill products, as the wheat was crushed entirely by iron rollers, and an examination of the amounts of alumina found in the mill products and in the whole grain indicate that it is no more foreign to the true ash than any of the other constituents named. To bring further proof on this point, 100 gm. of the unground wheat was carefully washed with distilled water, and after drying, was burned without being pulverized. The same amounts of both alumina and zinc were found as in the wheat which had not been washed. It seems a little remarkable that the zinc should have accumulated to the greatest extent in the ash of the bran while the alumina and silica should have reached their largest proportion in the ash of the finer flours. Alumina is found to be of frequent occurrence in the mineral waters of this State."

A sample of wheat grown in a sandy soil in Michigan was also examined for alumina and none was found.

"The finding of zinc in the ash of this wheat may be mentioned as a point of special interest. The amount found would equal about 1 lb. of pure zinc to each 500 bu. of wheat. So far as it has been possible to learn, this small amount of zinc has no special influence upon the growth of the plant nor is it in any way injurious to animals or human beings eating the grain. It is found most abundantly in the ash of the outer portions of the grain, and is present in the flour ash in much less quantities than in the ash of the bran. In the ripened wheat it seems to have been transferred almost completely from the straw to the grain. Zinc was also found in oats, clover hay, and corn cut before tasseling. All of these were produced upon soil in the vicinity of that producing the wheat which was used in the milling trial. An examination of the first 6 in. of this soil showed it to contain about 1 lb. of zinc to each 1,000 lbs. of earth."

Experiments to determine the coëfficients of digestibility of grain by hens, I. KALUGINE (*Zapiski Novo-Aleksandriiskago instituta Selvskago Khozyaistva ī Lyesovodstva, 9 (1896), III, pp. 217–257*).—Experiments were made with 2 hens on the digestibility of peas, buckwheat, wheat, and barley. Each experiment lasted 7 days and was preceded by a preliminary period of 2 days. The hens were kept in large, wooden cages. The floor and sides were lined with oilcloth, which could be removed at will and the feces easily collected. The details of food consumed and the composition of the food and excretory products are expressed in full in tabular form. The average coëfficients of digestibility are given in the following table:

Average coëfficients of digestibility of different grains fed to hens.

	Organic matter.	Crude protein.	Crude fat.	Nitrogen-free extract.	Cellulose.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Peas	75.00	90.32	83.71	91.65	13.74
Buckwheat	69.38	59.40	89.22	86.99	2.02
Wheat	81.92	56.91	55.21	93.30	29.95
Barley	77.17	79.22	68.29	89.17	....

The following conclusions were reached: In digestion experiments with hens the preliminary period may be limited to 2 days.

In some cases the percentage of nitrogen of metabolic products in the feces was the same as was found in experiments with swine; in other cases it was 2 or more times as great.

In the ability to digest the crude protein of peas and barley, hens do not differ from the ordinary farm animals. In their ability to digest the crude protein of buckwheat and wheat they are much inferior. In ability to digest fat they resemble in some respects herbivora and in other respects swine. Hens digest nitrogen-free extract very completely. In this respect they differ very little from farm animals. They digest crude fiber less completely than horses or swine. The gravel which hens consume is worn down in the intestinal tract to sand of different degrees of fineness and is excreted in the excretory products.

The fattening of cattle, J. W. ROBERTSON (*Canada Exptl. Farms Rpt. 1895, pp. 183–191*).—The author quotes the work of previous years (E. S. R., 6, p. 450) and reports 2 additional experiments. The first was made with 8 steers, divided into 2 uniform lots. During a preliminary period of 2 weeks both lots were fed a ration of 50 lbs. of corn silage, 30 lbs. of turnips and mangel-wurzels, and 15 lbs. of hay. The experiment proper lasted from January 17 to May 23, 1894, 18 weeks. Lot 1 was fed a ration consisting of 50 lbs. of corn silage, 5 lbs. of straw, and mixed grains composed of equal parts by weight of ground peas, barley, and wheat. Lot 2 was fed the same ration as lot 1, except that Robertson's silage mixture (composed of corn, horse beans, and heads of sunflowers) was substituted for corn silage. The mixed grain was weighed out to each animal separately. Lot 1 was fed 5 lbs. per day at first and the amount gradually increased to 7 lbs., and lot 2 was fed 1 lb. and gradually increased to 3 lbs. The details of the experiment are tabulated. The financial statement is based on corn silage at $2, Robertson silage at $2.50, straw at $4, and mixed grain at $20 per ton.

The average gain in weight of lot 1 was 164.75 lbs. and the cost of 100 lbs. of gain $8.32. The average gain in weight of lot 2 was 95 lbs. and the cost of 100 lbs. of gain $11.39. In the author's opinion the animals on the Robertson silage did not show a satisfactory gain during the first 12 weeks of the experiment.

The second experiment was made with 8 steers, divided into 2 uniform lots. It lasted from December 19, 1894, to June 5, 1895, and was divided into 2 periods of 16 and 8 weeks, respectively. Each lot was fed 25 lbs. of turnips, 5 lbs. of hay, and 6 lbs. of mixed grain (equal parts by weight of ground peas, barley, wheat, oil cake, and wheat bran). In addition lot 1 received 50 lbs. of corn silage and lot 2, 50 lbs. of Robertson silage. The mixed meal was weighed out to each animal separately, lot 1 being given 6 lbs. per head daily, and lot 2, 2 lbs. In the second period the corn silage and Robertson silage were reversed. One steer was dropped from each lot.

The financial statement is based on the same figures as the previous year, with the addition of hay at $8, roots at $4, and mixed grain at $20 per ton.

The total increase in weight of the steers on corn silage was 876 lbs. and the cost per 100 lbs. of gain $9.85; and the increase in weight on Robertson's silage was 951 lbs. and the cost of 100 lbs. of gain $7.75. The conclusion is reached that "the cost for food consumed per 100 lbs. of increase in weight was 27.1 per cent greater on corn silage, roots, hay, and meal than it was on Robertson's silage, roots, hay, and meal."

Feeding cattle, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1895, pp. 301–303*).—This is a report of experiments carried on at the Brandon Experimental Farm during 1895. A feeding experiment, lasting 72 days, was made with 4 steers, divided into 2 lots. Each lot was

fed 30 lbs. of corn silage, 5 lbs. of frozen wheat chop, and 2 lbs. of barley chop, and in addition lot 1 received 20 lbs. of cut native hay and lot 2, 20 lbs. of cut oat sheaves. The animals were fed all they would eat up clean.

The financial statement is based on oat sheaves at $7.50, native hay $5, and corn silage $2 per ton, wheat chop at ½ ct. per pound, and barley chop at 20 cts. per bushel. Details of the experiment are recorded in tabular form. The steers in lot 1 made a daily gain of 1 lb. 11 oz. and of lot 2, 2 lbs. 1 oz. These steers were sold for 4 cts. per pound. Lot 1 gave a profit of $38.15 and lot 2 of $37.93.

"Where native hay is not procurable, oat sheaves cut before ripe make an excellent substitute. The yield of dry oat sheaves on this farm ran from 2½ to 4 tons per acre this year."

Feeding sheaf wheat to pigs and steers, H. T. FRENCH (*Oregon Sta. Bul. 42, pp. 111–123, 128–131*).—*Experiments with pigs* (pp. 111–123).—Two feeding trials were made with Berkshire-Poland China pigs to compare sheaf wheat with mixed grains and with chopped wheat. The first trial was with 2 lots of 3 pigs each, and covered 8 weeks. The second trial was with 2 lots of 2 pigs each from the same litter, and covered 18 weeks. In each trial one lot was fed sheaf wheat (containing 35 per cent grain). The other lot in the first trial received a mixture of 3 parts of chopped wheat, 1 part of shorts, and 1 part ground oats; and in the second trial chopped wheat alone. The pigs were fed twice daily, and the mixed-grain ration was soaked in cold water from 9 to 15 hours.

The results of the 2 trials are fully tabulated. The financial results are based on chopped wheat at $16, shorts at $11, oats at $10, and mixed grain at $13.80 per ton, and sheaf wheat at 40 cts. per bushel. The average results are given in the following table:

Results of feeding sheaf wheat, mixed grains, and chopped wheat to pigs.

	Total weight at beginning of trial.	Average daily gain per head.	Food consumed.			Grain consumed per pound of gain.	Cost of food per pound of gain.
			Mixed grain.	Grain in sheaf wheat.	Chopped wheat.		
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Cents.
First trial:							
Lot 1 (mixed grain)	1,122	2.68	3,587	....	....	3.97	2.88
Lot 2 (sheaf wheat)[1]	1,127	.79	....	1,988.0	....	7.44	4.96
Second trial:							
Lot 1 (sheaf wheat)[1]	192	.61	....	1,161.6	....	7.54	5.00
Lot 2 (chopped wheat)	197	1.56	....	....	1,871	4.74	3.80

[1] Containing 35 per cent grain.

The following conclusions were drawn: Pigs do not relish sheaf wheat, nor is the wheat well digested. The gains made on sheaf wheat are more expensive than on ground grains. A proper mixture of grains gives better results than a single grain, and the gains on ground grain are more rapid than on sheaf wheat. Pigs can be better matured

when fed ground grain, and when slaughtered they will command a higher price.

Experiment with steers (pp. 128–131).—A trial was made with 4 grade Polled Angus steers about 3 years old. The steers were kept in a stall before the beginning of the test, to accustom them to it. They were then divided into 2 lots of 2 each. The test began November 21 and lasted 75 days. Lot 1 was fed sheaf wheat just as it came from the field, except that the bands were cut before placing it in the manger; and lot 2 was fed chopped wheat and oats and linseed meal. Both lots were given corn silage and clover hay in addition.

The financial statement is based on sheaf wheat at $13, corn silage at $1, clover hay at $4, chopped grain at $12, and linseed meal at $20 per ton. The steers in lot 1 weighed 885 and 890 lbs., respectively, at the beginning of the experiment, and gained an average of 0.96 lb. per head daily. They consumed an average of 21.9 lbs. of sheaf wheat (containing 35 per cent grain), 20.2 lbs. corn silage, and 4.9 lbs. clover hay per head daily. It required 7.82 lbs. of grain in sheaf wheat to make 1 lb. of gain. The cost per 100 lbs. of gain was $7.13. The steers in lot 2 weighed 930 and 785 lbs., respectively, at the beginning of the experiment, and gained an average of 1.96 lbs. per head daily. They consumed an average of 14.9 lbs. of clover hay, 40.5 lbs. of corn silage, 16.1 lbs. of chopped wheat and oats, and 4.1 lbs. of linseed meal per head daily. It required 6.01 lbs. of grain to make 1 lb. of gain. The cost per 100 lbs. of gain was $4.69.

The following conclusions were reached: Steers did not gain as rapidly on sheaf wheat as on ground grain, nor was the sheaf wheat relished by the animals. The cost of 100 lbs. of gain on sheaf wheat was greater than on ground grain. The difference was sufficient to pay for threshing and grinding under ordinary circumstances. Much of the grain was not well digested, and it had a tendency to scour the animals. Steers can not be as well matured on sheaf wheat as on ground grain, and therefore do not sell for as high a price. Better results can be obtained by feeding sheaf wheat to steers than to pigs. Sheaf wheat can not be stored as well as the ground grain.

Feeding potatoes to pigs, H. T. FRENCH (*Oregon Sta. Bul. 42, pp. 123–127*).—A test, to ascertain the feeding value of potatoes, was made with 10 pigs divided into 2 uniform lots. Lot 1 was fed a mixture of 1 part shorts and 2 parts chopped oats. The grain was wet with cold water and allowed to stand 8 to 12 hours before feeding. Lot 2 was fed a mixture of potatoes and shorts. The potatoes were cooked the day before they were fed until they would mash easily, and the grain was mixed with them while they were still hot.

The financial statement is based on shorts at $11 and chopped oats at $10 per ton and potatoes at 10 cts. per bushel. Lot 1 made an average daily gain of 1.8 lbs., and consumed 6.8 lbs. of mixed grain daily, an average of 3.8 lbs. for every pound of gain. The cost of pro-

ducing 100 lbs. of gain was $2.18. Lot 2 consumed 12.4 lbs. of potatoes and 2.8 lbs. of shorts daily and gained 1.3 lbs. This was 0.5 lb. less than the gains made by lot 1. The cost of 100 lbs. of gain was $2.86.

The following conclusions were reached: Both lots made good gains and were well matured. The pigs would not eat a larger ration of potatoes than was given them. To obtain the best results the amount of potatoes should have been decreased and more grain fed. The financial returns from the grain ration were better than from the ration of potatoes and grain. A mixture of grain fed with potatoes is better than shorts alone. Potatoes and other vegetables, cabbages, squashes, and pumpkins should be cooked before being fed. Although pigs may eat them raw, they are not eaten with relish.

Swine feeding, C. D. SMITH (*Michigan Sta. Rpt. 1895, pp. 134–142*).—A number of experiments to test different feeding stuffs for pigs are reported. In February, 1894, an experiment was made to test the value of skim milk and to compare wheat with corn. Twenty grade Poland China pigs, divided into 4 lots of 5 each, and one lot of 3 pure bred Essex barrows were used. The test lasted 6 weeks, except with lot 3, which was discontinued after 25 days, owing to the illness of one of the pigs.

Lots 1 and 3 were fed corn meal, lots 2 and 4 wheat meal, and lot 5, corn meal and wheat meal in equal quantities. All the lots were fed skim milk in addition. The financial statement is based on corn meal at $16 and wheat meal at $20 per ton. The results are given in the following table:

Results of pig-feeding experiment.

	Food consumed.			Weight at beginning.	Gain in live weight.	Dry matter eaten per pound of gain.
	Skim milk.	Corn meal.	Wheat meal.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1 (corn meal and skim milk)	1,853	1,079	....	586	330	3.45
Lot 2 (wheat meal and skim milk)	1,953	....	1,319	640	430	3.18
Lot 3 (corn meal and skim milk)	973	495	....	438	[1] 152	3.52
Lot 4 (wheat meal and skim milk)	1,376	....	924	420	344	2.79
Lot 5 (corn meal, wheat meal, and skim milk)	1,073	391	391	472	212	3.78

[1] Twenty-five days only.

The pigs were sold for $4.25 per 100 lbs. The total gain was $62.39. Taking from this the cost of the grain, the value of the skim milk is 28.4 cts. per 100 lbs.

The following conclusions were reached: The larger pigs in lot 5 required considerably more dry matter per pound of gain than the smaller pigs. Wheat compared favorably with corn as a food for young and growing pigs. Its economical use would depend on its price in comparison with corn.

A second experiment, which was begun in January, 1895, and lasted 5 weeks, was made with 10 lots of 7 pigs each. The objects were to test the value of skim milk, and to compare sweet and sour skim milk, corn and wheat, and feeding indoors and out of doors. Lot 8 was fed sour skim milk, and all the other lots sweet skim milk. In addition, lots 3 to 10, inclusive, were fed corn meal, or a mixture of corn meal with bran, wheat meal, or middlings.

Lot 5 was fed indoors and lot 10 out of doors. The financial statement is based on corn meal at $16, wheat meal at $20, bran at $14, and middlings at $15 per ton. The results of the experiment are shown in the following table:

Summary of results of pig-feeding experiment.

	Food consumed.		Average weight at beginning.	Gain in live weight.	Cost of grain.	Dry matter eaten per pound of gain.	Required for 1 lb. of gain.		Value of skim milk per 100 pounds.
	Skim milk.	Grain.					Milk.	Grain.	
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cents.*
Lot 1 (skim milk)	6,225	....	103.00	279	....	2.14	22.31	....	17.0
Lot 2 (skim milk)	1,914	....	31.75	99	....	1.85	19.33	....	19.9
Lot 3 (skim milk and corn meal)	4,224	545.5	88.70	422	4.36	2.09	10.00	1.29	27.6
Lot 4 (skim milk and corn meal)	4,040	520.0	66.10	406	4.16	2.09	9.95	1.28	27.9
Lot 5 (skim milk and corn meal)	4,708	959.0	168.30	456	7.67	2.86	10.32	2.10	20.5
Lot 6 (skim milk with corn meal and bran, equal parts)	3,852	668.0	79.60	359	5.00	2.68	10.73	1.86	19.8
Lot 7 (skim milk with corn meal and wheat meal, equal parts)	4,308	568.0	74.00	441	5.11	2.08	9.77	1.28	27.0
Lot 8 (skim milk with corn meal and wheat meal, equal parts)	4,108	548.0	72.00	382	4.93	2.31	10.75	1.43	23.3
Lot 9 (skim milk with corn meal and middlings, equal parts)	3,998	410.0	55.00	395	3.18	1.89	10.12	1.03	29.8
Lot 10 (skim milk and corn meal)	4,628	925.0	136.40	363	7.40	3.49	12.74	2.54	13.8

The pigs were sold for $3.80 per 100 lbs., yielding a profit of from $3.76 to $17.33 per lot. The following conclusions were reached:

"(1) The average returns per 100 lbs. for the skim milk, the prices for live pork and for grain feeds being as given, was 22.68 cts.

"(2) While skim milk fed alone to young pigs will support life and make them grow, it is much more economical to mix with it middlings and corn meal.

"(3) The better and more economical gains were invariably made with the smaller pigs. . . .

"(4) In this test sweet skim milk gave better returns than sour.

"(5) Wheat bran when soaked in skim milk is readily eaten by pigs, but does not seem so well adapted to form a part of their ration. It is too coarse and bulky. Although in this test it was fed with a less proportion of skim milk than was allowed the pens fed corn meal and milk, and therefore the conditions are not precisely identical, still the excess of dry matter required to produce a pound of gain is significant.

"(6) Wheat meal forms a very acceptable addition to the ration of young pigs, and can be economically used when its price per pound is not greater than corn.

"(7) Middlings and corn meal, with sweet skim milk, produced the greatest gains in proportion to the amount of dry matter consumed of any combination tested in this series. It was fed to the smallest pigs and was mixed with a larger proportion of milk, factors that must be taken into consideration. Still the fact that it required but 1.89 lbs. of dry matter to make a pound of gain shows clearly the value of the feed."

An experiment to test the value of mixed rations, of middlings for larger pigs, and of corn meal in comparison with corn on the cob and with barley meal was begun in February, 1895, and lasted 4 weeks. Seven lots of pigs were used. Lot 2 was fed corn on the cob, and lot 5 barley meal; the other lots were fed corn meal with barley meal, linseed meal, and middlings alone or in combination.

The results are shown in the following table:

Results of pig-feeding experiment.

	Food consumed.	Average weight at beginning.	Gain in live weight.	Dry matter eaten per 1 lb. gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1 (corn meal)	1,637	156.9	335	4.35
Lot 2 (corn on the cob)	1,637	158.1	289	5.02
Lot 3 (corn meal and middlings, equal parts)	1,326	140.0	289	4.06
Lot 4 (corn meal)	1,630	148.4	367	3.95
Lot 5 (barley meal)	1,368	137.6	269	4.53
Lot 6 (corn meal, barley meal, and middlings, equal parts)	1,290	120.1	327	3.51
Lot 7 (corn meal, linseed meal, and middlings, equal parts)	831	74.3	340	2.17

The pigs were sold at $3.80 per 100 lbs., yielding a profit of from $10.98 to $13.95 per lot. The following conclusions were reached:

(1) The larger pigs did not make as economical gains as the smaller ones.

(2) Larger and more economical gains were made on corn meal than on corn on the cob.

(3) Barley was not as valuable as corn for fattening pigs.

A test was begun August 23, 1895, and lasted 8 weeks. The value of soaked wheat and ground wheat was tested with 2 lots of 5 crossbred Duroc-Jersey-Essex pigs. Lot 1 was fed whole wheat soaked, and lot 2 wheat meal. Both lots were fed skim milk in addition. The whole wheat was at first fed in a trough, but as it was not properly masticated, later on it was scattered on the floor of the pen and the pigs were compelled to eat it more slowly. Lot 1 consumed 1,410 lbs. of skim milk and 1,043 lbs. of whole wheat, and lot 2 consumed the same quantity of skim milk and 1,025 lbs. of wheat meal. Lot 1 gained 344 lbs. and lot 2,370 lbs.

The pigs were sold for $3.80 per 100 lbs. If skim milk is reckoned at 27 cts. per 100 lbs., the wheat would be worth 60 cts. per bushel; if skim milk is reckoned at 20 cts. per 100 lbs., the wheat would be worth 65 cts. per bushel.

Feeding of swine, J. W. ROBERTSON (*Canada Exptl. Farms Rpt. 1895, pp. 191–196, fig. 1*).—The author quotes from previous work (E. S. R., 7, p. 608) and reports additional experiments with pigs to determine the effect on the quality of flesh of feeding wheat and buckwheat. Eight crossbred Tamworth and Poland-China pigs were divided into 3 lots of 3, 3, and 2 animals, respectively, and 8 crossbred Essex and

Yorkshire pigs were divided into 2 uniform lots. Lot 1 was fed a mixture of equal parts by measure of ground barley, rye, and wheat, and wheat bran soaked in cold water for an average of 30 hours; lots 2 and 4, a ration composed of equal parts by weight of the grain mixture fed to lot 1 and ground wheat soaked in cold water for an average of 30 hours; and lots 3 and 5 equal parts by weight of the same grain mixture as lot 1 and ground buckwheat soaked in cold water for an average of 30 hours. The results are tabulated.

Lot 1 consumed 3.44 lbs. of food per pound of gain; lot 2, 3.48; lot 3, 3.79; lot 4, 4.06; and lot 5, 4.24. The pigs were sold and slaughtered, and the live weight, dressed weight, and shrinkage are given for each lot.

The conclusion is reached that feeding a ration consisting of one-half ground buckwheat is not a cause of soft sides. "The percentage of shrinkage, from fasted weight to dressed weight 24 hours after killing, was 2.46 per cent less in the pigs fed on the grain mixture and ground buckwheat than in the pigs fed on the grain mixture and ground wheat."

The value of skim milk as a food for young and growing pigs was also tested with 3 lots. Lot 1, consisting of 1 crossbred Yorkshire and Tamworth and 2 crossbred Tamworth and Berkshire grade pigs, was fed a mixture of equal parts by measure of ground barley, rye, and wheat, and wheat bran soaked in cold water for an average of 30 hours. Lot 2, consisting of 1 crossbred Yorkshire and Tamworth pigs and 3 crossbred Tamworth and Berkshire grade pigs, was fed half as much of the same grain ration as the preceding lot and as much skim milk as they would consume in addition. Lot 3, consisting of 5 crossbred Berkshire and Yorkshire pigs, was fed on wheat shorts soaked in cold water for an average of 30 hours, and 30 lbs. of skim milk per day in addition. The results are expressed in tabular form.

"From these tests, from the tests in 1894, and from our experience in feeding young pigs, it appears that—

"(1) Skim milk may form the largest part of the feed of young and growing pigs with advantage and economy;

"(2) For the fattening of swine weighing on the average over 100 lbs. each, live weight, it is economical to give an allowance of skim milk not exceeding 5 lbs. per head per day;

"(3) In every case the swine fed with part of their ration of skim milk were lustier, more vigorous, and of a more healthy appearance than swine fed wholly on a ration for gain."

Report of poultry manager, A. G. GILBERT (*Canada Exptl. Farms Rpt. 1895, pp. 233–247, fig. 2*).—The author discusses at some length the different markets for eggs and the cause and prevention of bad eggs being placed on the market. The rations fed during the winter of 1894–'95 are described in detail and the number of eggs laid by the hens of each breed is given.

The morning ration consisted of a warm mash composed of ground wheat, oats, and barley or rye, and bran. Sometimes only 3 of the

grains were fed. At noon a light grain of some sort was fed to keep the hens busy scratching. In the afternoon a liberal ration of wheat or buckwheat, mostly the former, was fed. Sometimes cut bone was given instead of the morning or afternoon ration. Green food, in the shape of cabbages, turnips, or mangel-wurzels, was liberally fed, and occasionally clover hay was steamed and mixed with the mash. Broken oyster shells, mica, and grit were furnished the hens in liberal quantities, as well as an abundant supply of water. Ten lots of 11 hens, mostly pullets, were compared for egg production.

"The greatest egg production actually came from the Barred Plymouth Rocks, closely followed by the Langshans. The latter were, perhaps, the later hatched of the two. The White Minorcas did not show much vigor during the early part of the winter, and several of them died during the early part of the month of March. The Colored Dorkings were, apparently, late chickens, and were slow in maturing. The Brahma hens did not do well, as they were 3 years of age and were likely fat."

The eggs laid by the stock kept for breeding purposes are also recorded.

Early in March the different breeds were mated for breeding. The White Java eggs hatched remarkably well during all the season. The chickens were hardy and made rapid development. "The Light Brahma eggs did not do well, owing to the hens being 3 years of age and at that age predisposed to take on fat. The Plymouth Rock-Colored Dorking cross eggs hatched well." The feeding and care of the chickens and the egg production is discussed. The characteristics of some crossbreeds are given.

A trial has been made for 2 seasons of straw litter compared with sand and gravel. The results were altogether in favor of the straw.

An incubator trial and diseases of poultry are spoken of briefly.

Poultry, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1895, pp. 305, 306*).—This is a report of work carried on at the Brandon Experimental Farm during 1895. Barred Plymouth Rocks, White Leghorns, and Black Minorcas were compared. The morning ration consisted of half boiled roots and half ground wheat wet with skim milk. Dry grain, consisting of 25 per cent of barley, 25 per cent of oats, and 50 per cent of wheat, was fed in the evening. One ounce per head daily of ground green bone was also fed, and the fowls were supplied with fresh water and lime and grit. The largest number of eggs was laid by the White Leghorns, the next by the Plymouth Rocks, and the smallest by the Black Minorcas. The age and live weight of the poultry are given.

"Although the White Leghorns are excellent layers they are under weight for table fowl, and having prominent breast bones their shape is also against them for that purpose. The Plymouth Rocks sell readily as table fowls. The Black Minorcas appear to be in many respects midway between the White Leghorns and Plymouth Rocks."

Flour considered from the standpoint of nutrition, L. M. UNDERWOOD (*Alabama College Sta. Bul. 74, pp. 349-358*).—The author discusses the relative value of bread made from whole wheat and fine wheat flour, and gives a receipt for making

bread from whole wheat flour. Analyses are also given of flour of entire wheat and fine wheat flour, and the amounts of nutrients in a barrel of each are calculated. The author recommends the more extensive use of bread made from whole wheat flour.

Dietary of a mechanic's family (*New Jersey Stas. Rpt. 1895, pp. 123–129*).—This is an account of a dietary study made by the station in coöperation with this Department and reported in Bulletin 35 of this Office.

Composition and cost of bread in New Jersey (*New Jersey Stas. Rpt. 1895, pp. 129–137*).—This is an account of an investigation by the station in coöperation with this Department, reported in Bulletin 35 of this Office.

Bakery experiments (*New Jersey Stas. Rpt. 1895, pp. 137–147*).—An account of experiments made by the station in coöperation with this Department, reported in Bulletin 35 of this Office.

Foods at the Geneva Exhibition (*Ztschr. Nahr. Untersuch. und Hyg., 10 (1896), No. 23, pp. 387–389*).—A general article, describing some of the food exhibits.

Beechnuts as a feeding stuff (*Landw. Vers. Stat. Münster. Eine Denkschrift, 1896, p. 137*).—The composition is given of the kernel, shuck, and cake of beechnuts. The cost is too high for a feeding stuff. The author mentions the fact that beechnut oil is highly esteemed as a table oil and that the roasted nuts are used as a coffee surrogate.

Handbook of meat inspection, G. KJERRULF (*Handbok i Köttbesitgning. Stockholm, 1896, figs. 48, pls. 4; rev. in Jour. Hyg., 22 (1897), No. 1069, pp. 131, 132*).

Dietary standards, H. GILLET (*Formulaire des regimes alimentaires. Paris: J. B. Baillière, 1897; rev. in Jour. Hyg., 22 (1897), No. 1069, p. 132*).—A treatise on diet in health and disease.

Cotton-seed hulls and meal for beef production, F. E. EMERY and B. W. KILGORE (*North Carolina Sta. Rpt. 1895, pp. 219–253*).—A reprint of Bulletin 118 of the station (E. S. R., 7, p. 702).

Sheep feeding, C. D. SMITH (*Michigan Sta. Rpt. 1895, pp. 132, 133*).—A summary is given in tabular form of the work of the station on sheep feeding.

Fattening lambs, C. D. SMITH and F. B. MUMFORD (*Michigan Sta. Rpt. 1895, pp. 340–364, dgms. 3*).—A reprint of Bulletin 113 of the station (E. S. R., 6, p. 660).

Poultry department, C. D. SMITH (*Michigan Sta. Rpt. 1895, pp. 142, 143*).—A brief statement is given of the resources of the poultry department and plans for work.

VETERINARY SCIENCE AND PRACTICE.

Experimental studies of the Koch test for tuberculosis, J. NELSON (*New Jersey Stas. Rpt. 1895, pp. 179–246, pls. 4*).—These studies were planned to extend over one year, beginning March, 1895. The results for the first eight months are here given.

After a brief résumé of operations with the Koch test previously reported (E. S. R., 6, p. 332; 7, p. 709), and some unpublished work done for the State Tuberculosis Commission, the author gives a summary of the leading results and their bearings. Following this is a description of an autopsy of a cow and 36 tables showing in detail the reactions obtained from successive injections on the herd experimented upon.

It may be stated that all lymph used in the experiments was received from the Bureau of Animal Industry of this Department, and that 30 minims is considered a full dose. This, however, was employed rarely,

the injections ranging from 19 to 25 minims, 20 minims, or a two-thirds dose, being employed for a cow of average size.

It is pointed out that all cases showing an undoubted reaction indicate the presence of tuberculosis, that tuberculosis can not be eradicated without the slaughter of animals reacting doubtfully, and that the law of temperature fluctuations is not well enough understood to form accurate inferences relative to the presence and extent of reactions. Further, it is stated that good care of animals will not strengthen them so as to enable them to withstand an exposure to the germs, and that in large herds it is to be presumed, until the contrary is proved by the tuberculin test, that tuberculosis is present.

Summarizing the work so far as it has been carried, the author states that—

"(1) Absence of reaction under the Koch test is not certain proof of the absence of tuberculosis. Cows may fail to react at the first or second injection and on subsequent injection give the fever reaction, indicating the presence of tuberculosis.

"(2) Repeated injection of tuberculin made on a sound animal did not seem to affect its health, and, above all, did not produce in her any apparent tendency to react to the later injections; therefore, if a cow which has failed to react in previous tests does react subsequently, such reaction is evidence of a tuberculous condition, and not due to the effect of tuberculin alone.

"(3) Each repetition of the injection on an animal that has given a reaction is, unless a long time intervenes, accompanied by a lower reaction than in the previous test. The power to react, or the sensibility to injected tuberculin, is rapidly reduced by repeated injection. Therefore, whenever an animal gives a doubtful reaction during the application of the Koch test, the uncertainty is only increased by repeating the injection. The repeated test may dispose the veterinarian to declare the animal to be sound, even when tubercles are undoubtedly present.

"(4) The temperature of the air influences a cow's temperature in some instances very markedly, and must be taken into account in interpreting temperature sheets, especially in summer. Humidity seems to have no effect."

With reference to cases originally indicated by the test as sound but subsequently found suspicious, the author affirms that either the animals had latent tuberculosis when first tested, or they were afterwards infected. He favors the first explanation, and states that it is an error to assume, when on an autopsy a tuberculous lesion is found, even in an old cow, that infection is recent, and that cows 9 to 14 years old may have been tuberculous all their lives and still the disease have gained headway only at special intervals. The great variation in the extent of reaction is taken as proof that susceptibility is developed progressively, but inasmuch as susceptibility has no relation to the extent of disease, it is believed probable that the sensitiveness may vary periodically. In support of his statement regarding the extent of tuberculosis in a latent condition, he cites the experience of Stalker and Niles[1] and of L. Parson[2] and adduces the case of the autopsy of a cow already mentioned. In this animal, which had reacted to the

[1] Iowa Sta. Bul. 29 (E. S. R., 7, p. 804).

[2] Pennsylvania Sta. Rpt. 1894 (E. S. R., 7, p. 987).

second injection but had not to subsequent ones, extensive tuberculosis was found which was certainly of old standing, for, with the exception of those in the thoracic glands, the tubercles were surrounded by an unusually dense coat of connective tissue.

"The more this matter is investigated the greater must the conviction become that if we are to use the Koch test for purposes of eradicating tuberculosis from among the cattle of the country, we have a more difficult task before us than is usually believed by exponents of the tuberculin test. We need to proceed with greater care and less confidence. It requires heroic measures and patience in their application. Eradication can not be rapidly nor easily effected."

Further experiments with an attenuated tuberculosis bacillus, A. E. DE SCHWEINITZ and E. C. SCHROEDER (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 13, pp. 11–14*).—An account is given of experiments with attenuated tuberculosis bacillus upon a monkey and 18 guinea pigs. The monkey received inoculations of tubercle cultures, thirtieth and thirty-second generations, and lived 6 months. Death occurred from natural causes, and *post-mortem* examination revealed no signs of tuberculosis. Similar results followed inoculation of guinea pigs. The authors conclude that their experiments "have proved conclusively the attenuated character of this germ. Although this germ is so attenuated and innocuous to animals, its ability to grow in artificial media is as good and better than ever, and the tuberculin obtained from its culture is as satisfactory as that prepared from a more virulent germ."

The growth of the tuberculosis bacillus upon acid media, E. A. DE SCHWEINITZ and M. DORSET (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 13, pp. 7–10, pls. 2*).—The authors find that the bacillus cultures will grow upon meat broth of an acidity requiring the addition of 21.6 cc. decinormal sodium hydrate solution to neutralize 100 cc. of the media; upon artificial media requiring 45 cc. of sodium hydrate solution for neutralization; and upon the acid beef broth and acid artificial media to which from 1 to 3 per cent of one-half normal hydrochloric acid has been added. After the growth of the tuberculosis germ upon the media described is well advanced and apparently has ceased, the acid reaction of the cultures is still more marked. The growth of the germs and their morphological changes as observed by the authors differ from those reported by other investigators. Plates are given showing the appearance of the growth upon different media. The authors believe certain changes in the morphology of the germ indicate the presence of heteromorphic forms of the tuberculosis bacillus and a genuine pleomorphism caused by the changed conditions of life.

"If the germ is transferred from an acid culture after it has been cultivated on acid media for a number of months to a neutral nutrient fluid it will no longer grow. There would seem from this to be probably a poisonous principle secreted by the germ. It may be a true acid or, more likely, a substance with an acid reaction. In the experiment, as the germs used for inoculation still floated on the surface of the

culture, they should have been alive, unless some substance especially inimical to their growth was produced in the cultures.

"These experiments show clearly that the tuberculosis bacillus can be readily accustomed to an acid nutrient fluid, that it can easily adapt itself to the changed conditions of life, and that even a small amount of free hydrochloric acid does not interfere with its growth. They tend to show further, we think, that under certain conditions there is probably a poisonous substance produced by the germs which is inimical to their own life."

Serum diagnosis of hog cholera, C. F. DAWSON (*Separate from N. Y. Med. Jour. 1897, Feb. 20, pp. 3*).—The author has made an application to hog cholera of a method discovered by Widal for diagnosing with ease and certainty the existence of typhoid fever. In Widal's method, a bouillon culture of typhoid bacillus is subjected to microscopical examination to determine the isolation and motility of the individual bacteria. A drop of blood from the patient and a few drops of the culture are then mixed together on a watch glass and a hanging-drop culture made. It is found that the bacilli lose their motility and become aggregated into masses which are separated by wide spaces. The latter are dotted with less motile bacteria, which may be seen to approach the masses and finally become adherent to them. Such phenomena are not found in preparations made from the blood of healthy persons nor from those suffering from such diseases as nephritis, tuberculosis, pneumonia, icterus, and rheumatism.

In the author's experiments, which are preliminary to more extended investigations, a rabbit was inoculated with hog cholera by a subcutaneous injection of a bouillon culture. Five days later a little blood from the ear of the rabbit was smeared on a clean cover glass and allowed to dry. Then a drop of bouillon culture of hog cholera bacillus was placed upon the dried blood and the cover glass inverted over a hollow ground slide and examined microscopically. By the time the bacilli had been brought into focus they were found to have become motionless and aggregated into clumps exactly as described by Widal in reference to the typhoid bacillus. A control experiment made with the blood from a normal rabbit exhibited no such phenomena. Experiments made to learn the effect of hog cholera blood serum upon typhoid fever bacillus and the *Bacillus coli communis* gave negative results. The method is believed to be of considerable value, as it will enable the detection of hog cholera before the ordinary symptoms are apparent.

Report of the commissioners on diseases of domestic animals, 1896 (*Rpt. [Connecticut] Comm. Diseases Domestic Animals, 1896, pp. 23*).—The report deals entirely with tuberculosis, and states that out of 6,304 cases examined, 14.2 per cent, or 897, were condemned. Six hundred and fourteen herds were tested, of which 397 contained no evidence of disease. *Post-mortem* examinations of the others revealed 146 very bad cases, 640 well marked, 85 light, and 19 cases in which no lesions were discoverable by the naked eye. The report goes on to state that the method of testing by injection of tuberculin is growing

very much in favor. The customary directions for disinfection are given, as well as the forms of permits and certificates required by the State, and also the text of the quarantine regulations adopted by the Connecticut State Board of Agriculture.

A study of skin tumors of horses and mules in Alabama, S. L. COLEMAN (*Alabama College Sta. Bul. 72, pp. 310–334, figs. 12*).—General observations are given upon causes, macroscopical and microscopical characteristics, and surgical and medical treatment of affections of this kind based upon studies of cases brought to the free clinics of the college. Figures are given showing structure of slide sections and general appearance of some of these growths. Brief notes are appended upon cases treated during 4 years, which are classified as follows: Fibromas, 41; granulation tumors, 4; papillomas, 10; sarcomas, 5; and sarcinomas, 3.

The parasitic diseases of poultry, F. V. THEOBALD (*London: Gurney & Jackson, 1896, pp. 120, figs. 23*).—A short manual for the poultry keeper, describing briefly the common vegetable and animal parasites of poultry, together with the symptoms produced by and the remedies to be used against them.

The development and purpose of veterinary hygiene, OSTERTAG (*Ztschr. Fleisch und Milch Hyg., 7 (1897), No. 6, pp. 105–114*).—An address, with bibliography appended.

The hygiene of domestic animals, H. GEORGE (*Jour. Agr. Prat., 1 (1897), No. 4, pp. 135–137*).

Experiments with peat litter containing sulphuric acid for prevention of contagious animal diseases, KÜNNEMANN (*Mitt. deut. landw. Ges., 1897, No. 2 (?), pp. 23, 24*).—From experiments of Stutzer[1] and Eber, and original experiments by the author, the latter believes that peat litter containing 2 per cent of free sulphuric acid will exert a favorable influence in the prevention and repression of certain contagious diseases.

Prevention of animal diseases by the use of litter treated with sulphuric acid, W. EBER (*Mitt. deut. landw. Ges., 1897, No. 5, pp. 64, 65*).—From experiments with cattle and pigs the author believes it impossible to prevent disease by the use of acid litter.

Contagious abortion of cows, REINDL (*Fühling's landw. Ztg., 46 (1897), No. 4, pp. 114–119*).

Concerning actinomycosis, A. HABEL (*Arch. path. Anat. und Physiol., 146 (1896), No. 1, pp. 1–35*).

Pleuro-pneumonia in goats, STORCH (*Berl. Tierärztl. Wochenschr., 1896, No. 48; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 3, pp. 105, 106*).

On the treatment of a case of tetanus in a horse with tetanus antitoxin, W. DIECKERHOFF and B. PETER (*Berl. Tierärztl. Wochenschr., 1896, No. 50; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 3, p. 118*).

The bovine tick fever, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 760–787, pls. 5, figs. 2*).—An account is given of the Texas fever in Australia.

Hereditary tuberculosis in calves, KLEPP (*Ztschr. Fleisch und Milchhyg., 1896, No. 10; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, p. 61*).

A study of tuberculosis in small animals, CADIOT (*La Semaine Medicale, 1896, p. 462; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, pp. 61, 62*).

Tubercular infectiousness of milk, J. C. BAY (*Ann. Rep. Iowa Dairy Commissioner, 1896; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, p. 63*).

Tuberculosis in a dog, U. G. HOUCK (*Vet. Mag., 3 (1896), No. 3, p. 183; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, p. 62*).

A new method of staining tuberculosis bacilli, A. RONDELLI and L. BUSCALIONI (*Abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, pp. 70, 71*).

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[1] Centbl. Bakt. und Par. Allg., 2 (1896), p. 841.

Tuberculosis and its prevention, F. P. WILLIAMSON and F. E. EMERY (*North Carolina Sta. Rpt. 1895, pp. 201–214*).—A reprint of Bulletin 117 of the station (E. S. R., 7, p. 617).

The prevention of tuberculosis (*Diet. and Hyg. Gaz., 13 (1897), No. 4, pp. 241–244*).—This article, reprinted from the *British Medical Journal*, points out the danger of infection from several sources, and urges the necessity of precautionary measures.

Tuberculosis of the parrot, C. SCHENKLING-PRÉVÔT (*Ornith. Monatsschr., 4 (1896), No. 7, pp. 110–112*).—Endeavors to determine whether tuberculosis of birds, mammals, and man are identical.

Investigation of milk for tubercle bacilli, A. BUEGE (*Inaug. Diss. Halle, 1896; abs. in Centbl. Bakt. und Par. Med., 21 (1897), No. 2, p. 70*).

Wormy fowls, N. A. COBB (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 746–753, figs. 8*).

The need of sanitary science and its value to the State, S. BURRAGE (*Purdue University Monographs, No. 1, pp. 27*).—This bulletin treats of sanitary science, its foundation, purpose, and scope; sanitary legislation abroad and at home; and sanitary work and public experimentation; with an appendix summarizing the acts governing the Massachusetts State Board of Health.

DAIRY FARMING—DAIRYING.

The amount of albuminoids precipitated from milk by heating, P. SOLOMIN (*Arch. Hyg., 28 (1896), No. 1, pp. 43–48*).—The object was to determine what proportion of the nitrogenous substance of milk was precipitated or coagulated by heating at different temperatures. Milk was heated for 15 minutes (in one case an hour) at constant temperatures varying from 55 to 140° C., cooled, filtered, the precipitate extracted with ether, dried, and weighed. In separate cases the ash, nitrogen, and phosphorus were determined. The precipitation of proteids commenced at 60°, a small amount being separated. Since milk albumen is said to coagulate at from 72 to 80°, according to the concentration and salt content, it is suggested that the proteid separated at 60° may be milk globulin. The amount of proteids precipitated increased with the temperature, though quite irregularly. At 80° and above the precipitate contained traces of organic phosphorus, indicating that casein was being thrown down. The precipitate at 100° was usually too small to account for all of the albumen indicated by analysis. By heating milk in an autoclave at 110 to 120° in general, no larger amount of albuminoids was separated than at 100°. At 130 to 140° the casein and albumen were nearly completely precipitated, and about half of the ash was inclosed in the coagulum, including all of the lime in combination with phosphoric acid.

Kajmak, A. ZEGA (*Chem. Ztg., 21 (1897), No. 6, p. 41*).—This is a dairy product of first importance in Eastern Turkey. It is made in a very primitive way by heating milk to boiling, allowing it to stand in large vessels, usually of wood, for 12 hours, removing the "skim" which forms, salting this, and packing it in firkins. Hence, it comes nearest to being a sort of cream cheese.

The average composition of 10 samples is given as: Water 31.55, fat 55.79, nitrogenous substances 6.25, ash 4.5, milk sugar 2.01, and salt 3.07 per cent. In taste it is very little like butter, and changes with age, but as a rule is somewhat sour, and ranges from that of Thun and Gais cheese to Roquefort cheese.

A case of bitter milk and its cure, DAMMANN (*Deut. Tierärztl. Wochenschr., 1897, No. 1; abs. in Milch Ztg., 26 (1897), No. 4, p. 56*).—The author discovered the cause of a case of bitter milk of long standing to be in the failure of the urine to drain off properly from the stalls, which otherwise were kept clean. This difficulty was removed, the udders of the cows washed with warm 2 per cent soda solution, the canals in the teats syringed with a 3 per cent aqueous solution of boric acid, and the drop behind the cows was soaked with a 3 per cent Kreolin solution. After this the trouble disappeared.

Fodder corn and straw compared with native hay for feeding milch cows, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1895, pp. 303, 304*).—This is a report of an experiment carried on at the Brandon Experimental Farm during 1895. The animals used were an Ayrshire and a Holstein cow, and the experiment was divided into 3 periods of 16 days, 38 days, and 16 days. In the first and third periods the basal ration consisted of 40 lbs. of fodder corn and straw, 60 lbs. of corn silage, 10 lbs. of wheat chop, and 4 lbs. of barley chop. In the second period 40 lbs. of native marsh hay was substituted for the fodder corn and straw. As much of the ration was fed as the animals would eat up clean. The food consumed and the milk produced are recorded.

The average milk yield for the cows fed the corn feed was 42 lbs. 2 oz., and for those fed hay, 41 lbs. 5 oz.

"From the results of this experiment it would appear that farmers living at a distance from hay marshes may find fodder corn a good substitute for hay in feeding cows."

The dairy (*Michigan Sta. Rpt. 1895, pp. 143–158*).—This consists of popular statements in regard to milk, the fermentations of milk, practical suggestions for preventing infection in the stable, the general treatment of milk to avoid this, the methods employed in washing the dairy utensils at the station, some physical and chemical properties of milk, creaming milk, churning, butter making, etc.

Samples of skim milk from 11 farmers in the vicinity of the college who raised their milk by shallow setting, showed the percentage of fat to range all the way from 0.3 to 2 per cent, the average being 0.71 per cent.

Illustrations are given of the creaming in cold deep setting of the milk of fresh cows, and cows well advanced in lactation. In the case of a cow which had been in milk for 17 months the skim milk averaged 1.08 per cent of fat, while in the case of a fresh cow, the fat in the skim milk ranged from a trace to 0.4 per cent. When the milk

of the two cows was mixed, the skim milk contained 0.25 to 0.27 per cent of fat. From various experiments at the station in creaming milk by cold deep setting the indications are that the percentage of fat in the skim milk increases when the temperature rises above 45°, and that the fat is less fully recovered when the setting is delayed.

A cheap form of creamer is briefly described.

College herd (*Michigan Sta. Rpt. 1895, pp. 125–131*).—This is a record for nearly a year and a half of 17 cows in the station herd, showing the yield of milk and fat and the average percentage of fat for each cow by months.

"These tables reveal the fact that no mature cow is retained in the herd whose annual milk record is less than 6,000 lbs. or which does not yield at least 300 lbs. of fat per year. In her first period of lactation, College Houwtje yielded but 239.45 lbs. of fat but has already yielded at the close of this record 249.31 pounds, although her milking period is still incomplete."

Remarks are made upon the selection of young heifers for dairy stock, keeping of herd records, etc.

Brief mention is made of some feeding experiments which have been conducted at the station.

"There are several conclusions that may be safely drawn from our feeding trials which do not need further trials for confirmation. They are given here without details.

"(1) Gluten meal and gluten feed are very palatable to cows and may be used economically in compounding rations for them. They tend to produce a soft, sticky butter, however, and further tend to so affect the cream as to leave a high percentage of fat in the buttermilk.

"(2) *Lathyrus silvestris*, either as green forage, hay or silage, is not liked by cows, either as a principal or subordinate part of the ration. Repeated trials have shown that cows will not eat it in sufficient quantities to make it an economically valuable forage plant.

"(3) Millet can be safely put into a silo directly from the field. A small silo of millet silage kept without waste and was eaten with avidity by the cows."

The effect of tuberculin injections upon the milk of healthy and diseased cows, E. A. DE SCHWEINITZ (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 13, pp. 15–27, charts 7*).—This is a continuation of observations on this subject reported in a previous bulletin.[1] The observations were made with varying doses of tuberculin on a healthy cow, 2 diseased animals, and a lot of 8 cows which had been condemned by the tuberculin test and were to be killed. Data are given for each animal, showing the composition of the milk on different days and the temperatures before and after injection; and charts are given showing the variation in temperature of large numbers of animals after inoculation.

"There was practically no variation in the fat of the milk from the healthy cows after the tuberculin injection. This agrees with our first experiments, and also with some tests made by Dr. Law.[2] Neither was there any alteration when large

[1] U. S. Dept. Agr., Bureau of Animal Industry Bul. 7 (E. S. R., 6, p. 845).

[2] New York Cornell Station Bul. 82 (E. S. R., 6, p. 1023).

doses, 30 cc. of tuberculin, were injected [into a healthy cow]. The second and third injection with tuberculin of No. 145 and 161, diseased respectively, caused no appreciable rise of temperature, but there was a decided decrease in the amount of fat. [In the second test of the lot of 8 condemned cows], however, the 2 animals that showed no rise in temperature failed to show any decrease in the milk fat. When the rise of temperature was noted in the others a marked decrease in fat was also noted.

"A comparison of the decrease in fat with the extent of the disease, as revealed by autopsy except in case No. 234, a generalized one, does not apparently show any relationship. The oldest cases seemed to give the least change in fat, while the newer cases gave the largest variation. . . .

"The variation in fat should, of course, be attributed in part to the fever. But that this is not the only cause is also evident. The variation is not, judging from the few tests made, sufficient of itself to prove the presence of tuberculosis, but taken in conjunction with the rise of temperature might be considered as corroborative evidence."

The opinions of the Paris Committee and the International Congress of Veterinary Medicine, at Berne, on the value of tuberculin are cited.

"The statement that the tuberculin injection causes the disease to spread more rapidly is not warranted by facts, and in many instances the use of tuberculin has apparently caused an improvement in the disease. . . .

"No. 285, an animal condemned for tuberculosis about a year ago, has been kept at the station since that date. At first she was injected with small doses of tuberculin until she ceased to give a reaction and was again apparently well. The injections of tuberculin were increased in number and quantity, and on March 20, 1895, the date of the last examination of the milk, the animal received an injection of 100 cc. Previous to that date she had received altogether 565 cc. of tuberculin. The last injection caused no change in the amount of fat or in the temperature."

A comparison of the Babcock test and the gravimetric method of estimating fat in skim milk, E. H. FARRINGTON (*Wisconsin Sta. Bul. 52, pp. 3–7, figs. 15*).—The object of these observations was to show as nearly as possible by drawings just what fraction of a per cent is represented by the few globules of fat in the neck of the test bottle in testing skim milk containing a minimum amount of butter fat. Samples of skim milk were tested by the Babcock method and the fat also estimated by gravimetric analysis for comparison. The results of these comparisons are figured.

It is considered impracticable to attempt to estimate less than 0.05 per cent of fat by the Babcock test.

Two bottles are illustrated which have been devised for testing samples of buttermilk or skim milk, one holding twice the usual quantity of milk and acid, and the other having a double neck. The results of comparisons of the Babcock test and the gravimetric method on 12 samples of skim milk, using the double-neck bottle, are tabulated.

"The double-necked bottle is provided with a much finer graduated tube for measuring the fat than any other test bottle. Each division is so long that fractions of 0.1 per cent can be estimated as the graduations represent 0.05 per cent fat. . . . The double-necked bottles gave results which agreed very well with the gravi-

metric analysis, even when the latter showed only 0.1 per cent of fat, and this amount of fat could be distinctly read by the graduations of this test bottle, although in either of the other test bottles reading so small an amount of fat requires more or less guesswork."

The alkaline tablet test of acidity in milk or cream, E. H. FARRINGTON (*Wisconsin Bul. 52, pp. 8–16, figs. 3*).—This test, devised by the author (E. S. R., 6, p. 248), is described and popular directions are given for its use in selecting milk, testing its acidity, testing cream, etc. A table is given showing the percentage of acid corresponding to each cubic centimeter of tablet solution. The application of the test in detecting the presence of preservaline in milk is described (E. S. R., 8, p. 436).

A study of milk in relation to health and disease, G. M. KOBER (*14th Biennial Report State Board of Health of California, 1894–'96, pp. 128–176*).—This is a popular article on the above subject treated under the heads of (1) normal milk, (2) preparation of milk and dairy products, (3) dietetic and therapeutic uses of milk, (4) impure milk in relation to infantile mortality and other infectious diseases, and (5) the germ theory of disease and dairy bacteriology. Numerous references are made to the scientific work done in these several lines, and the article concludes with a bibliography.

Influence of the tuberculin test on the milk flow of cows, MÜLLER (*Deut. Tierärztl. Wochenschr., 1896, No. 50, pp. 415, 416*).

Milk records and tests, F. E. EMERY (*North Carolina Sta. Rpt. 1895, pp. 185–196, fig. 1*).—A reprint of Bulletin 116 of the station (E. S. R., 7, pp. 605, 629).

Process of reducing proportion of casein in milk, G. GAERTNER (*Off. Gaz. U. S. Pat. Office, 79 (1897), No. 1, p. 44*).—This patent covers Gaertner's prepared milk and the process for making it, previously patented in several European countries.

Concerning a poison-producing bacillus found in ice cream and cheese, V. C. VAUGHAN and G. D. PERKINS (*Arch. Hyg., 27 (1896), No. 4; abs. in Centbl. Bakt. und Par. Allg., 2 (1896), No. 24–25, pp. 799, 800*).

A color-forming micrococcus of red milk (*Centbl. Bakt. und Par. Med., 21 (1897), No. 5, pp. 177–179*).

Bacteriological investigations of Kephir, E. VON FREUDENREICH (*Landw. Jahrb. Schweiz., 10 (1896), pp. 1–20, pl. 1, figs. 2; also in Centbl. Bakt. und Par. Allg., 3 (1897), No. 2–3, pp. 47–54, figs. 2*).

The nomenclature of the bacteria of lactic fermentations, G. LEICHMANN (*Ztschr. Spiritusind., 1896, No. 38, p. 305*).

Tests of dairy implements and practices, F. E. EMERY (*North Carolina Sta. Rpt. 1895, pp. 133–159, figs. 4*).—A reprint of Bulletin 114 of the station (E. S. R., 7, p. 426).

The testing of milk, F. E. EMERY (*North Carolina Sta. Rpt. 1895, pp. 101–127, figs. 7*).—A reprint of Bulletin 113 of the station (E. S. R., 7, pp. 422, 423, 429).

A handbook for farmers and dairymen, F. W. WOLL (*New York: John Wiley & Sons, 1897, pp. 375, figs. 5*).—This is "a third edition of the dairy and agricultural calendars previously published by the author," containing brief discussions on subjects of importance and interest to farmers and dairymen, together with useful facts, tables, formulas, recipes, agricultural statistics, etc. The range of information presented is very broad and includes matter relating to feeding, manuring, growing of various field and horticultural crops, seeds and weeds, forestry, agricultural engineering, human foods, dairy cows, milk, cream, butter, cheese, management of creameries and cheese factories, various tables of weights and measures, statistical matter, and other useful information. The book is well printed, has a comprehensive index, and should prove a valuable addition to the library not only of farmers and dairymen, but of all who have occasion to refer to the wide range of subjects which it covers.

AGRICULTURAL ENGINEERING.

Earthen dams, S. FORTIER (*Utah Sta. Bul. 46, pp. 56, pl. 1, figs. 14*).—This bulletin discusses the character of materials used in earthen dams, methods of making a compact embankment and of constructing core walls, the dimensions of reservoir embankments, slope paving, outlet pipes and conduits, waste weirs or overflows, and State supervision of dams and reservoirs. The Connecticut and Idaho laws relating to dams and reservoirs are given in an appendix.

An account is given of experiments at the station to determine the best proportion in which to mix gravel, sand, silt, and clay in order to produce the most compact and impervious mass ("concrete"). In these experiments the size of the particles was determined and also the weight per cubic yard for each grade of soil in its dry state and the percentage by volume of open space. The latter was determined by pouring a given volume of the material from a height of 0.85 ft. into a known volume of water, the volume of water required to fill the interstices being taken as the percentage by volume of open space. The different mixtures or "concretes" were prepared as follows:

Formulas for different clay concretes.

	No. 1.	No. 2.	No. 3.	No. 4.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Gravel	1.00			
Fine gravel		.90	.90	1.00
Coarse sand	.25			
Fine sand		.56		
Very fine sand	.27			
Medium sand				.51
Clay	.43		.58	
Silt		.42		.26
Total	1.95	1.88	2.04	1.77

"When mixture No. 1 was thoroughly mixed dry and poured from a height of 0.85 ft., its volume was 1.546 cu. yd. When thoroughly mixed and tamped dry in one-tenth of a foot layers, its volume was 1.240 cu. yd. When poured slowly into water and mixed, its volume was 1.26 cu. yd. When moistened sufficiently to form a stiff paste and tamped in one-tenth of a foot layers, its volume was 1.312 cu. yd.

"When mixture No. 2 was mixed dry and poured from a height of 0.85 ft., its volume was 1.526 cu. yd. When mixed dry and thoroughly tamped, its volume was 1.294 cu. yd. When mixed dry and poured from a height of 0.85 ft. into water, mixed but not tamped, and the excess of water drained through holes covered with canvas in the bottom of the box, its volume was 1.256 cu. yd. When mixed dry and moistened with 0 277 cu. yd. water at a temperature of 41° F. into a stiff paste and well tamped, its volume was 1.296 cu. yd.

"No. 3 is identical with No. 2, except that 0.58 cu. yd. of clay is substituted for 0.42 cu. yd. silt. When mixture No. 3 was mixed dry and poured from a height of 0.85 ft., its volume was 1.604 cu. yd.; when mixed dry and well tamped, 1.324 cu. yd. When mixed dry and poured from a height of 0.85 ft. into water, mixed but not tamped, and drained of excess water, its volume was 1.432 cu. yd. after experiment; 1.420 cu. yd. after 1 day; 1.360 cu. yd. after 2 days; 1.356 cu. yd. after 4 days; 1.324 cu. yd. after 15 days. When mixed dry and moistened with 0.307 cu. yd. of water into

a paste and well tamped, its volume was 1.348 cu. yd., which shrunk but slightly in 4 days.

"When mixture No. 4 was mixed dry and tamped, its volume was 1.26 cu. yd. When mixed dry and poured from a height of 0.85 ft. into water, and mixed but not tamped, its volume was 1.204 cu. yd. When mixed dry and moistened with 0.30 cu. yd. water into a stiff paste and well tamped, its volume was 1.212 cu. yd."

Devices for obtaining a constant flow in laterals with variable heads in the main canals or reservoirs, A. M. RYON (*Montana Sta. Bul. 11, pp. 49–58, figs 4*).—The importance of better means of controlling and measuring irrigation water is pointed out and three devices for this purpose are described—the Decker siphon module and automatic prorater, Foot's spill box, and an automatic gate designed by the author. The latter is a gate operated and controlled by a float and a weight, so arranged that a rise in the water of the canal raises the float and closes the gate, thus equalizing the flow. The use of this device involves no loss of head in the main canal, but a loss in the lateral, amounting in the test here reported to 0.6 to 0.9 ft. in addition to the head used by the measuring box.

Traction tests, S. T. NEELY (*U. S. Dept. Agr., Office of Road Inquiry Bul. 20, pp. 9–22, pls. 2, figs. 7*).—An account is given of traction tests on the roads of the United States road exhibit at the Cotton States and International Exposition at Atlanta in 1895, and on roads in the vicinity of Washington. Tests were made on macadam, sand, and dirt roads, level and with different grades, and on asphalt pavement, with a tractometer, in which the amount of force which the team exerted was weighed by a spring in compression, and was indicated on an arc by means of a pointer, and by a "tractograph," an apparatus similar to that used on steam engines to obtain indicator diagrams. The tractograph differed from the tractometer in that "a long arm, holding a pencil at its end, was attached to the end of the piston which previously moved the pointer. The pencil point rested on a revolving cylinder which was placed in front of the spring and piston and extended longitudinally along the pole. This cylinder was made to turn by means of gear driven directly by one of the front wheels of the wagon. A further change was made by substituting a single long spring in place of the two short springs previously used."

The results with the tractometer are summarized as follows:

"On the smoothest possible macadam road surface the force of traction was not constant, but changed continuously within a range of 50 lbs.

"On the ordinary dirt road the force varied from 0 to 700 lbs. (in a gross load of 3,000 lbs.), becoming in effect a rapid succession of violent jerks.

"Some method should be adopted of making a more elastic connection between the wagon and the team, thus transmitting the shocks at the wheel rims as a gradual change of force to the team.

"On heavy grades, in the case of the smooth road, the force was more nearly constant.

"The force necessary to start a load on the smooth road was 4 times as great as the force required to draw the load at a uniformly slow pace when started and was one-tenth the gross load.

"The force required to start a load on the dirt road was about one-fourth the gross load, or not greatly in excess of the upper limit of the tractive force when the wagon was in motion. . . .

"During these experiments a team of small mules readily drew 12 bales of cotton[1] on a heavy wagon up the 10 per cent grade of the macadam road, the tractometer indicating a pull of 1,000 lbs. The same team was stalled completely in going down the 6 per cent grade of the sand road, after pulling the indicator to 1,900 lbs. Nine bales of cotton were removed before the load could be again gotten in motion. The driver refused to venture at all upon the dirt road with the 12-bale load.

"*Wide tires and narrow tires.*—There was also a test made to demonstrate the practical advantages of wide tires over narrow tires. A piece of clay road was made thoroughly wet. Over one portion of the mud road thus formed a heavily loaded wagon with 2-inch tires was repeatedly drawn. Over the other portion a wide-tired wagon, whose gross load was made equivalent to that of the first, was hauled an equal number of times. The tires of the latter wagon were 4 and 5 in. wide and the front axle was shorter than the rear, so that the wheels did not run in the same track. The result was very satisfactory. That part of the road which the narrow-tired wagon traversed was cut and rutted to the depth of several inches, while the remainder was rolled by the wide tires into a smooth surface. Afterwards the tractometer was brought upon this road and it was found that twice as much pull was necessary to draw the same load over that half of the road which had been subjected to narrow tires as over the other half."

The results with the tractograph indicate that—

"the draft on a dirt road is about 2½ times as much as that on a macadam road, and this when conditions are most favorable to the former, namely, when it is perfectly dry and smooth; . . . that it required nearly 7 times as much effort to draw the load up the 10 per cent grade as along the level roadway; . . . and that with a team going at an ordinary walking pace the tractive force on an old asphalt pavement is 26 lbs.; the tractive force on a good macadam pavement is 38 lbs., and the tractive force on a good dirt road is 96 lbs."

Data obtained in similar tests by Morin and McNeill are given in an appendix.

Hillside terraces or ditches, F. E. EMERY (*North Carolina Sta. Rpt. 1895, pp. 319–326, pls. 2, figs. 4*).—A reprint of Bulletin 121 of the station (E. S. R., 8, p. 91).

Progress of road construction in the United States (*U. S. Dept. Agr., Office of Road Inquiry Bul. 19, pp. 47*).—This is a condensed report of the proceedings of the National Road Parliament held at Atlanta, Georgia, October 17–19, 1895. Besides an address of welcome, address of the president, R. Stone, and "miscellaneous remarks," this bulletin gives reports on road making from the following States: Alabama, Arkansas, California, Connecticut, Florida, Georgia, Illinois, Louisiana, Maine, Massachusetts, Michigan, Mississippi, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, and Virginia.

STATISTICS.

Agricultural products imported and exported by the United States in the years ended June 30, 1892 to 1896, inclusive (*U. S. Dept. Agr., Section of Foreign Markets Circ. 11, pp. 8*).

Sources of the principal agricultural imports of the United States during the five years ended June 30, 1896 (*U. S. Dept. Agr., Section of Foreign Markets Circ. 12, pp. 24*).

[1] A bale of cotton weighs about 500 lbs.

Freight charges for ocean transportation of the products of agriculture, October 1, 1895, to October 1, 1896 (*U. S. Dept. Agr., Division of Statistics Bul. 12, misc. ser., pp. 53*).—This bulletin includes tables showing the value of domestic exports, the transatlantic and coastwise traffic rates, and freight charges in England on agricultural products by the principal railway systems.

Reports of director and treasurer of Michigan Station, 1895 (*Michigan Sta. Rpt. 1895, pp. 99–103*).—Brief notes upon station work, including a list of bulletins issued; and a financial statement for the fiscal year ending June 30, 1895.

Ninth Annual Report of Mississippi Station, 1896 (*Mississippi Sta. Rpt. 1896, pp. 4*).—A financial statement is given for the fiscal year ending June 30, 1896, and a list of lines of experiment are given.

Reports of director and treasurer of New Jersey stations, 1895 (*New Jersey Stas. Rpt. 1895, pp. XV, 1–8, XII, 169–175*).—Brief accounts of work at the stations, and financial statements for the fiscal year ending June 30, 1895.

The work during 1895 of the North Carolina Agricultural Experiment Station (*North Carolina Sta. Rpt. 1895, pp. LXI, 458*).—This includes reports upon the work of the year by the director, agriculturist, first assistant chemist, botanist and entomologist, horticulturist, and meteorologist; a financial statement for the fiscal year ending June 30, 1895; and reprints of bulletins issued during the calendar year 1895.

Ninth Annual Report of South Dakota Station, 1896 (*South Dakota Sta. Rpt. 1896, pp. 32*).—The director's report discusses at some length the changes in station organization and the resulting unfavorable effect upon work of the year; notes the discovery of tuberculosis in the station herd, and briefly indicates principal lines of work.

A financial statement for the fiscal year, as reported on blanks prescribed by this Department, and outlines of work by heads of Departments are also given.

Miscellaneous agricultural topics (*North Carolina Sta. Rpt. 1895, pp. 163–180, fig. 1*).—A reprint of Bulletin 115 of the station (E. S. R., 7, p. 581).

Miscellaneous agricultural topics (*North Carolina Sta. Rpt. 1895, pp. 372–383*).—A reprint of Bulletin 123 of the station (E. S. R., 8, p. 353).

Civil Service in the Department of Agriculture, C. W. DABNEY, JR. (*U. S. Dept. Agr., Office of Experiment Stations Circ. 33, pp. 10*).—This is a reprint of an address delivered by the author before the Association of American Agricultural Colleges and Experiment Stations in November, 1896.

NOTES.

MISSISSIPPI STATION.—S. M. Tracy, director, and H. E. Weed, entomologist, have resigned their positions, to take effect at the close of the present college year.

NEW YORK STATE STATION.—F. H. Hall, for several years connected with the Office of Experiment Stations, has resigned to accept the position of editor and librarian at this station.

NEW YORK CORNELL UNIVERSITY AND STATION.—The New York State legislature has appropriated $25,000 to the College of Agriculture for experimental and university extension work. The following additions to the station staff have been made: J. L. Stone has been appointed assistant agriculturist; H. B. Cannon, chief clerk; G. A. Smith, assistant in dairying; J. W. Spencer and G. T. Powell, in charge of work of instruction; C. Hunn, assistant horiculturist; A. L. Kneisley, assistant chemist; and B. M. Duggar, assistant botanist.

WASHINGTON STATION.—The substation at Puyallup will be closed temporarily at the end of this fiscal year.

WYOMING STATION.—The State legislature at its last session made no appropriation for the substations. The equipment of the Wheatland Substation will be removed to the main station at Laramie.

PUBLIC LABORATORY AND EXPERIMENT STATION IN JOHANNESBURG, SOUTH AFRICAN REPUBLIC.—An account in a recent number of *Chemiker Zeitung, 21 (1897), No. 14, p. 122*), by J. Loevy gives a report for 1896 for this institution, which has been in operation since April, 1891. The work of the year included analyses of mineralogical specimens, explosives, potassium cyanid, bat guano, water, milk, butter, distilled liquors, coffee, and drugs. The metallurgical experiment station conducted a large number of experiments, principally on the extraction of gold with potassium cyanid.

PERSONAL MENTION.—Dr. Fisher von Waldheim succeeds the late Dr. Batalin as Director of the Imperial Botanic Garden at St. Petersburg.

Gaston Bonnier has been elected a member of the Botanical Section of the Academy of Sciences of the Institute of France.

Robert Hogg, one of the leading horticulturists of England, died March 14, in his 79th year.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Experiment Station Record, Vol. I, 6 numbers; Vol. II, 12 numbers; Vol. III, 12 numbers and index; Vol. IV, 12 numbers, including index; Vol. V, 12 numbers, including index; Vol. VI, 12 numbers, including index; Vol. VII, Nos. 1–11; Vol. VIII, Nos. 1–4.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894; No. 20, Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Chicago, Illinois, October, 1893; No. 21, Methods and Results of Investigations on the Chemistry and Economy of Food; No. 22, Agricultural Investigations at Rothamsted, England; No. 23, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895; No. 24, Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., November 13–15, 1894; No. 25, Dairy Bacteriology; No. 26, Agricultural Experiment Stations: Their Objects and Work; No. 27, Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896; No. 28, The Chemical Composition of American Food Materials; No. 29, Dietary Studies at the University of Tennessee in 1895; No. 30, Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Denver, Colorado, July 16–18, 1895; No. 31, Dietary Studies at the University of Missouri in 1895; No. 32, Dietary Studies at Purdue University, Lafayette, Indiana, in 1895; No. 33, The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding; No. 18, Forage Plants for the South; No. 21, Barnyard Manure; No. 22, The Feeding of Farm Animals; No. 23, Foods: Nutritive Value and Cost; No. 25, Peanuts: Culture and Uses; No. 26, Sweet Potatoes: Culture and Uses; No. 29, Souring of Milk and Other Changes in Milk Products; No. 32, Silos and Silage; No. 34, Meats: Composition and Cooking; No. 35, Potato Culture; No. 36, Cotton Seed and its Products; No. 37, Kafir Corn: Characteristics, Culture, and Uses; No. 39, Onion Culture; No. 41, Fowls: Care and Feeding; No. 44, Commercial Fertilizers: Composition and Use; No. 46, Irrigation in Humid Climates.

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beatt

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII   No. 11

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, PH. D., *Director*,

AND

E. W. ALLEN, PH. D., Assistant Director—Chemistry, Dairy Farming, and Dairying.
W. H. BEAL—Meteorology, Fertilizers (including methods of analysis), Soils, and Agricultural Engineering.
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R. A. EMERSON—Horticulture.
J. I. SCHULTE—Field Crops.
With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

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ZOÖLOGY.

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EXPERIMENT STATION RECORD.

Vol. VIII. No. 11.

The question as to effect of food on the composition of milk has again been opened, and by no less an authority than Professor Soxhlet, of Munich (see p. 1016). In the present unsatisfactory state of our knowledge of the physiological side of milk production, any scientific contributions on the subject can not fail to be of interest, for until we can learn more definitely the true relation between food and milk, experiments on the value of this or that feeding stuff or ration for milk production can hardly contribute much to the science of feeding for milk and must be confined mostly to the financial side of the question.

In his latest published work Professor Soxhlet shows that in some of the experiments which have been regarded as conclusive on certain points and which have had much to do with shaping the general opinion of the effect of food on milk, rations were fed which were less digestible than was assumed, *i. e.*, that the particular substances tested, like fat, were added to the basal ration in such form that they were not digested by the animal. Hence, no effect could be reasonably expected. His investigations lead him to believe there is no direct transmission of fat from the food to the milk, as some have held; but that normal milk fat is a product of the activity of the lacteal glands, and that its source is the body fat of the cow. The fat of the food affects the secretion of milk fat by replacing a part of the body fat, and thus causes a transmission of the body fat to the milk. He is confident that the fat of the food can effect a one-sided increase in the fat content of the milk; but he states that the fat is the only food constituent capable of doing this.

Feeding oils, tallow, etc., in such form that they could be assimilated by the animal body resulted in an increased production of fat, but when the same fats were fed in different form they were without effect because they were not digested. On this ground of failure of digestion Professor Soxhlet explains many of the negative results in "feeding fat into milk," which have been regarded as strong arguments in the theory that the fat can not be increased by feeding. This suggests the necessity in all feeding work of this kind of determining to what extent the rations are actually digested, and especially when substances are fed which may themselves fail to be digested or affect the digestibility of the other ingredients of the ration. This point may prove to be of much importance in interpreting the real effect of various materials added to the basal rations, not only in this particular line of work, but also in other feeding experiments.

A REVIEW OF PUBLICATIONS ON AGRICULTURAL BOTANY ISSUED IN FRANCE DURING 1896.[1]

EDMOND GAIN,
Dean of the Faculty of the University of Nancy (France).

CULTURE.

Investigations relating to the culture of plants will be given in the following order: The soil, fertilizers, and general and special culture.

The soil.—The importance of a knowledge of the soil from the standpoint of culture is shown by the increased activity during 1896 in the preparation of soil charts. This subject has been discussed in a general way by A. Carnot,[2] who explains the value of such work in facilitating the application of commercial fertilizers and in saving the farmers the necessity of a chemical analysis of each soil. Soil charts have already been prepared for ten of the departments of France. L. Magnien[3] has issued for Cote d'Or charts showing the geological and agronomic features, and giving the chemical and physical composition of the soil and subsoil for each geological formation. The nitrogen, phosphoric acid, potash, magnesia, lime, etc., are also graphically shown. Similar charts have been prepared for other departments.[4] Sometimes cheap editions of these charts are published which can be sold at a low price, and in other cases two copies only are made by hand, one of which is deposited in the office of the mayor, where it is accessible to the public, and the other is placed in the hands of the professor of agriculture or other authorized person who explains it to all interested parties.

Bernard,[5] of the agricultural station of Cluny, has made a new classification of arable soils based upon what he terms "the cube of constitution and the cube of fertility." The methods employed in the preparation of these charts are very variable, and there is need of more uniformity in this work. Flahault[6] has published a chart of France, showing the geographical distribution of agricultural and other plants, that is useful in determining the plants adapted to definite regions. Schlössing[7] has made a study of the amount of nitrates in running water and in drainage water. The different streams of a given drainage basin have about the same nitrogen content. The proportion of nitrogen reaches the maximum after a prolonged period of low temperature which checks the growth of aquatic plants and the flow of the water.

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[1] Continued from p. 853.

[2] Rev. gén. sci. pur. et appl., 1896, Sept. 30, p. 766.

[3] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, pp. 55, 177.

[4] Brochure presented at Congrès de Carthage, 1896.

[5] Brochure Géologie agr. et cartes agron., 1896.

[6] Ann. Géographie, Paris: Colins, 1896.

[7] Compt. Rend., 122 (1896), pp. 699, 824 (E. S. R., 7, p. 848).

The influence of the nature of soils upon different crops was studied by Ville in 1860, Grandeau in 1868–'88, and more recently by Raulin,[1] who has reported the results of his experiments with clover, beets, wheat, and potatoes. The optimum composition of the types of soil for the different crops as shown by his experiments were as follows:

Optimum relative composition of soils.

	Clover.	Beets.	Wheat.	Potatoes.
Clay	6	2	16	7
Sand	58	48	52	64
Humus	2	10	7	6
Lime	34	40	25	23
Total	100	100	100	100

Such investigations will assist in determining the best relative proportion of the soil constituents for each of our cultivated plants.

Dehérain and Demoussy[2] have studied the circulation of air in the soil, and have arrived at the conclusion that in order to secure the proper aëration and circulation of water, soils should be mixed with marl or lime, so that after a hard rain the water will be promptly carried off. Dehérain[3] has recently discussed the practice of fallowing. He has shown in experiments in boxes that fallowing may be profitable where the supply of fertilizers is limited, and especially where weeds are allowed to grow, but since the production of manure has so greatly increased and nitrate of soda is so readily secured the practice of fallowing can hardly be economically pursued.

The same authors[4] have shown that the oxidation of organic material goes on rather actively at from 40 to 60°. From this it would appear that in tropical regions soils tilled without the application of fertilizers would become sterile through the disappearance of the humus. In temperate regions this disappearance is slower, although constant. In an experiment field at Grignon, where different crops were cultivated and where no fertilizer was used, the soil lost half its organic matter in 10 years. Where manure is liberally used it is necessary to stir the soil in order to admit the oxygen which renders the humus available as plant food.

Lechartier[5] has made soil analyses by means of plants—alfalfa, which was grown upon a variety of soils in different states of fertility. It is claimed that by comparing the composition of imperfectly developed plants with that of normal plants the lack of fertilizing elements in the soil may be ascertained.

Fertilizers.—Claudel and Crochetelle[6] have reported experiments

[1] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 410.
[2] Compt. Rend., 122 (1896), p. 109; Ann. Agron., 22 (1896), p. 49 (E. S. R., 7, pp. 644, 751).
[3] Ibid., p. 122; Ann. Agron., 22 (1896), pp. 297, 515 (E. S. R., 7, p. 848).
[4] Ibid., 123 (1896), p. 278 (E. S. R., 8, p. 208).
[5] Jour. Agr., 1 (1896), p. 256; Compt. Rend., 121 (1895), p. 866 (E. S. R., 7, p. 752).
[6] Ann. Agron., 22 (1896), p. 131 (E. S. R., 8, p. 55).

upon the influence of various fertilizers upon germination, in which it was shown that alkaline fertilizers with lime and potash for their bases were favorable to the germination of leguminous seed. Slag and liquid manure produced a better effect than lime alone.

Dehérain[1] has published an important work on the fertilizers and ferments of the soil, in which the importance of ferments as fertilizing agents is pointed out.

Larbalétrier and Malpeaux[2] have investigated the action of magnesia fertilizers. By means of pot cultures verified by field tests they have shown that magnesium sulphate is more efficient than magnesium carbonate. Soils containing as much as 0.021 per cent of magnesia are not benefited by the addition of magnesium compounds.

The general subject of phosphatic fertilizers has been considered by numerous investigators. Of work in this line may be mentioned the comparative tests of different kinds of phosphates by Nay de Mézence,[3] which gave results favoring dried superphosphates as compared with the ordinary kind; Risler's[4] investigations on soils poor in phosphoric acid; Grandeau's[5] on the assimilation of phosphates; Trabut's[6] on the use of natural phosphates; Couture's[7] on the phosphate deposits of Algiers and Tunis; and Aubin's[8] on the assimilability of Thomas slag. Pagéot[9] has recommended the superphosphates as more efficient on acid soils than the phosphates. Truffault[10] has written upon the action of fertilizers in horticulture and their effect upon the crop. Dehérain[11] has given advice relative to the management of barnyard manure, and Trabut,[12] in his investigations on nitrification, has studied the question of the conservation of manure, and has shown that by acidifying the litter a loss of from 50 to 70 per cent of the nitrogen was prevented. Lafargue[13] has reported upon the subject of humus and green manuring. Comon[14] has studied the effect of fertilizers upon the starch content of potatoes. He was able to increase their starch content 3 per cent by the use of phosphatic and potash fertilizers. Vassilliere[15] has demonstrated the superior value of nitrate of soda as a wheat fertilizer.

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[1] Les engrais et les ferments de la terre; Paris: Rueff et Cie, 1896, pp. 222 (E. S. R., 7, p. 489).

[2] Ann. Agron., 22 (1896), p. 20 (E. S. R., 7, p. 756).

[3] Jour. Agr. Prat., 1 (1896), p. 909; 2 (1896), pp. 70, 753.

[4] Ibid., 2 (1896), p. 88.

[5] Bul. Agr. Alger. et Tunis., 1896, No. 4, p. 78.

[6] Ibid., p. 75.

[7] Bul. Soc. Agr. France, 1896, No. 1, Supp. p. 289.

[8] Ibid., p. 300.

[9] Jour. Agr. Prat., 2 (1896), p. 444.

[10] Sols, terres, et composts utilises en horticulture; Paris: Doin, 1896, pp. 310.

[11] Bul. Agr. Alger. et Tunis., 1896, No. 20, p. 469.

[12] Ibid., No. 21, p. 543.

[13] Bul. Soc. Agr. France, 28 (1896), No. 1, Supp. p. 308.

[14] Jour. Agr. Prat., 1 (1896), p. 816.

[15] Ibid., p. 13.

Bourgne[1] has made a test of fertilizers on meadows. He found that the use of potash and phosphatic fertilizers increased the proportion of leguminous plants in mixed meadows from 10 to 20 and even 30 per cent, depending upon the kind of fertilizer used, slag giving the greatest increase. Nitrogenous fertilizers served to increase the proportion of grasses. The results of four years' experiments with chemical fertilizers on beets are reported by Vivier.[2] He states that the yield increased and the density of the juice decreased as the amounts of nitrate of soda applied to the crop increased. Based on the sugar or alcohol product, applications of less than 800 kg. of nitrate of soda per hectare were without benefit. Sulphate of ammonia was more profitable than nitrate of soda. Superphosphates and muriate of potash gave conflicting results, and are to be investigated further.

General culture.—One of the most important investigations in this line is that of Raulin[3] on distance of planting. He gives curves showing the variation in weight of the plant and of the yield per hectare. In general it is shown that the total weight of the crop increases with a decrease in the distance between the plants. This increase is less rapid as the distances become smaller and finally a limit is reached beyond which there is a decrease instead of an increase. The variations depend largely upon the kind of plant, the development of its roots, and the fertility of the soil. The author claims that for each species of cultivated plant there is within certain limits an optimum distance of planting which gives the greatest net return. This return depends not only upon the total weight of the harvest, but also upon its value, the weight of the seed, and the labor employed. The value of the product depends upon its quality—the weight of the seed and proportion of starch and gluten in cereals, the starch content in potatoes, and sugar in beets. The proportions of these substances vary with the distance of planting. The investigation of this important question was left in an incomplete condition by the death of Raulin.

Attention is called to the notes by Grandeau[4] on the nutrition of leguminous plants, and Naudin[5] on the root tubercles of these plants. The latter author maintains that some of the Leguminosæ resist inoculation, while others are indifferent to it. The author regards it as extremely doubtful whether leguminous plants are benefited by symbiosis with bacteria, except indirectly by the improvement of the soil by the nitrogen which the bacteria contain.

Damseaux[6] has studied the effect of sulphurous anhydrid upon soils and agricultural products. Metallurgical works liberate large quantities of this poisonous gas and its presence is shown by its effect on the

[1] Jour. Agr. Prat., 2 (1896), p. 862.

[2] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 374.

[3] Ibid., p. 394.

[4] Jour. Agr. Prat., 2 (1896), pp. 329, 571.

[5] Compt. Rend., 123 (1896), p. 666.

[6] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 121.

composition of the plants, the ash often being doubled. A high content of sulphuric acid is associated with a deficiency of phosphoric acid, potash, etc. The eating of plants charged with sulphurous fumes by animals may cause trouble in connection with parturition or may result in a special disease which Haubner has called the acid disease ("maladie acide").

Fleury-Berger[1] claims that comfrey, hairy vetch, and *Lathyrus sylvestris* are not worthy of the attention which has been given them in recent years.

Rousseau[2] has made a study of intensive culture in some of the French colonies, especially on the introduction of caoutchouc trees and the best method of extracting their product. He has studied the species adapted to cultivation, choice of soils, and collection and preparation of the gum for market.

C. Rabot[3] in his travels through Scandinavia traced the limits of altitude for cultivated plants and forest products in Northern Scandinavia and adjacent regions.

An interesting report has been made upon the development of the experiment gardens of Tunis.[4] These include orchards and nurseries for the culture of fruit and other trees, such as the grape, olive, carob, eucalyptus, acacia, opuntia, etc., and fields for testing forage plants, such as sulla and cereals, cotton, ramie, Rumex, etc.

Special culture.—In addition to the special articles in *Revue de Viticulture* and *Progrès Agricole et Viticole* there have appeared numerous articles pertaining to vineyard management. Among these may be mentioned those of Viala,[5] who has experimented on the action of different liquids when taken up by the grapevine. Perraud[6] has compared the various systems of grape pruning. Rigaux[7] has conducted fertilizer experiments, and Blin[8] won the agricultural prize of the Society of Agriculturists (*Société des Agriculteurs*) for his work on the care of vineyards. Guillon[9] has published a book on oriental vineyards, and Ravaz one on American vines as grafting stocks. The latter[10] has also published an article on the renovation of vineyards. Gervais[11] has published a book on the adaptation of grapes to calcareous soils and the renovation of vineyards on such soils, and Viala and Ravaz[12] have published a treatise upon the same subject.

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[1] Jour. Agr., 2 (1896), p. 785.
[2] Congrès Soc. Savants, Sec. Bot., 1896, pp. 44, 118.
[3] Rev. gén. Bot., 8 (1896), p. 385.
[4] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 187.
[5] Bul. Soc. Nat. Agr., 1896, No. 5, p. 311.
[6] Paris: Masson, 1896.
[7] Les engrais de la vigne, Toulouse, 1896.
[8] Bul. Soc. Agr. France, 28 (1896), pp. 617, 664.
[9] Paris: Carré, 1896.
[10] Choix des porte greffes; Bordeaux: Firet, 1896.
[11] Paris: Masson, 1896; Bul. Soc. Agr. France, 28 (1896), pp. 702, 739.
[12] Paris: Didot, 1896.

Something like a dozen articles have been published in France during the year relating to the culture of beets, which in France represents an annual product valued at about $50,000,000 and employs more than 200,000 laborers. One of the most important contributions to this subject is that of Larbalétrier and Malpeaux,[1] who give a detailed account of the present state of beet culture and discuss the varieties best adapted to forage, sugar, and distilling uses, and report upon seed, fertilizers, soil, culture, diseases, harvesting, yield, cost of culture, etc. Vivien[2] has experimented with a view to producing a large yield of beets of a high sugar content. This he concludes does not depend entirely upon the choice of seed, but is also influenced by the fertilizer. The employment of slightly less than the usual amount of nitrogenous fertilizer decreases the cost of production and increases the net return. This conforms with results recently obtained in Germany. Sagnier[3] has studied seed selection of beets by physical and chemical methods. The effect of stripping the leaves from beets has been investigated by Chassant.[4] Tests of varieties of sugar beets have been made at the experiment station of Cappelle.[5] Dehérain[6] has studied forage beets, and Lépinez[7] has investigated beet culture without irrigation. Denaiffe[8] investigated the fertilizer requirements of forage beets, and ascertained the effect of phosphoric acid upon this crop. He applies on soils of average fertility equal amounts of phosphoric acid and nitrogen. This supplies an amount of phosphoric acid only half that recommended by many agriculturists.

In the study of the culture of potatoes the experiments of A. Girard[9] are of special value. He has shown that the starch content of the seed tuber does not influence the yield of the crop. He has proven that the entire reserve material in a tuber is not needed for the perfect development of a plant, and that in planting a given variety it is useless to seek for those tubers having the highest starch content. It is in the intensity of hereditary traits of tubers obtained from vigorous hills that we must seek the influence which will increase the amount and quality of the yield. The same author[10] has published articles on the improvement of potato culture, as well as on the disputed subject of the proper size of cuttings of tubers for planting, his conclusions being

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[1] Rev. gén. sci. pur. et appl., 1896, p. 633.

[2] Jour. Agr. Prat., 1 (1896), p. 168; Rapport Com. Agr. St. Quentin, 1896.

[3] Jour. Agr., 2 (1896), p. 665.

[4] Ibid., p. 311.

[5] Ibid.

[6] Bul. Agr. Alger. et Tunis, 1896, No. 20, p. 459.

[7] Ibid., No. 21, p. 483.

[8] Jour. Agr., 1 (1896), p. 658.

[9] Bul. Soc. Nat. Agr. France, 1896, No. 4, p. 215; Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 440.

[10] Bul. Soc. Nat. Agr. France, 1896, No. 4, p. 250; Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 453.

based upon the results of an extensive series of experiments.[1] In a recent report[2] he claims that sound whole tubers of medium size will give the best returns. Vilmorin[3] has given the results of experiments with 40 varieties of potatoes in which the yield per hectare and percentage of starch were determined. Riviere[4] has reported upon some experiments on potatoes in the desert regions of Algeria.

In wheat culture but two important publications have appeared. Vilmorin[5] has investigated the subject of seeding wheat, and he concludes that the true wheats should be sown in good season in autumn. Late seeding and reseeding with spring wheats is to be condemned. Desprez[6] has reported an extensive series of experiments with wheat at the station of Cappelle, in which many varieties were tested. The tests were made on experimental fields for general culture, on experiment plats for detailed tests, and on other fields to apply in ordinary culture the results obtained on the experimental plats.

Among contributions to forestry, attention is called to the work of Henry[7] on the weight and composition of the dead leaves of forests. He shows that the weight of dead leaves in a standard coppice is at a minimum soon after cutting, from which time it gradually increases for about 10 years and then remains nearly constant until the next cutting, the dry matter amounting to about 5,500 kg. per hectare in Lorraine. In older forests of large trees it may increase to 7,000 to 8,000 kg. per hectare. Small twigs and branches enter into the total, often amounting to $\frac{1}{4}$ or $\frac{1}{3}$ of the entire weight. From tables given in the article the weight of the different mineral constituents is readily ascertained. A 20-year-old coppice growing on calcareous soil yielded 542 kg. of ash per hectare, containing 22.8 kg. of phosphoric acid, 15.4 kg. of potash, and 182 kg. of lime. On a clay soil the yield of ash was 490 kg., containing 28.8 kg. of phosphoric acid, 33.3 kg. of potash, and 123 kg. of lime. This investigation supplements the work of Ebermayer in Bavaria, published in 1876. Briot[8] has made a very important contribution to alpine economy, in which he treats of the management of high meadows, reforestation, etc. Crevat[9] has made physiological studies of certain conifers that might well be extended to other species of trees. The National Society of Agriculture[10] has investigated the subject of introduction of foreign trees capable of growing in France. Mouillefort has recommended the following as promising additions to the forest

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[1] Bul. Soc. Nat. Agr. France, 1896, No. 2, p. 107.
[2] Ann. Sci. Agron., ser. 2, ann. 2, 1 (1896), p. 428.
[3] Bul. Soc. Agr. France, 28 (1896), Supp. May 1, p. 522.
[4] Bul. Soc. Nat. Agr. France, 1896, No. 4, p. 209.
[5] Ibid., No. 1, p. 50.
[6] Jour. Agr., 2 (1896), p. 348.
[7] Compt. Rend., 122 (1896), p. 144.
[8] Études sur l'économie alpestre; Paris: Berger Levrault, 1896.
[9] Jour. Agr. Prat., 1 (1896), pp. 89, 132, 204.
[10] Bul. Soc. Nat. Agr. France, 1896, No. 1, p. 37.

flora of France: *Liriodendron tulipifera*, *Ostrya virginica*, *Juglans nigra*, *J. cinerea*, *Abies pinsapo*, *A. cephalonica*, *A.* sp.? *Pseudotsuga douglasi*, *Pinus strobus*, *Thuya occidentalis*, *Cedrela sinensis*, and *Parrotia persica*. Dollfus[1] has published an account of the culture of the cork oak in Spain and Portugal, and Thil[2] has given anatomical and physical descriptions of transverse sections of 100 species of native woods. Huffel[3] has described the royal forests of Prussia, and Duval[4] has established the fact that *Platanus orientalis* was introduced into France in 1582 instead of 1754, as generally believed. This opinion is confirmed by the researches of Trelease, of the Shaw Botanic Gardens of St. Louis, Missouri.

In addition to the above, mention may be made of the following publications of more or less importance: Culture and value of carrots for forage, by Denaiffe,[5] and by the same author[6] on the culture and comparative value of forage vetches as shown by trials at Ardennes; improvement of clovers by selection, by Schribaux;[7] the culture of oats on poor soils, as shown by field trials at the Station de l'Est, by Grandeau;[8] culture of lupines, by Guilloteaux,[9] in which the conclusions of Schulze regarding fertilizers and seeding are confirmed; and contributions to the knowledge of cactus and sulla as forage plants, by Bourde.[10]

In botanical horticulture Rivière[11] has given a review of the condition of horticulture in Algeria, where for a long time but little advance was made. Costantin and Matruchot[12] have made some improvements in the culture of mushrooms.

Attention is called to the movement in France toward the improvement of agriculture in her colonies. At the Carthage Congress a resolution[13] was adopted favoring the establishment of a school of agriculture in Algeria. Agricultural experts have been sent to study the culture of different crops in various countries, and reports have already been made on the culture of rice in Austria,[14] the culture of cotton in Egypt,[15] general condition of agriculture at Cape of Good Hope,[16]

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1 Bul. Soc. Nat. Agr. France, 1896, No. 1, p. 53.

2 Ibid., p. 30; Paris: Tempère, 1896.

3 Bul. Min. Agr. France, 15 (1896), p. 563.

4 Bul. Soc. Bot. France, 3 (1896), p. 194.

5 Jour. Agr., 2 (1896), p. 266.

6 Ibid., p. 793.

7 Bul. Soc. Nat. Agr. France, 1896, No. 4, p. 201.

8 Jour. Agr. Prat., 1 (189), pp. 127, 161.

9 Bul. Soc. Nat. Agr. France, 1896, No. 2, p. 72.

10 Brochure Tunis, 1896.

11 Rev. gén. sci. pur. et appl., 1896, No. 16, p. 707.

12 Bul. Soc. Agr. France, 28 (1896), Suppl. Apr. 1, p. 471.

13 Bul. Assoc. Fr. Av. Sci., Congrès de Carthage, p. 238; Rev. gén. sci. pur. et appl., 1896, Dec.

14 Bul. Min. Agr. France, 1896, p. 171.

15 Ibid., p. 172.

16 Ibid., p. 175.

culture of hops in Austria,[1] ramie culture in the United States,[2] coffee culture in Mexico,[3] and olive culture, diseases, and varieties.

AGRICULTURAL PRODUCTS.

The scientific study of yeasts has been conducted for some time. Kayser[4] in a short treatise has shown the present state of information on this subject, and has given a bibliography of the more important works published during the past 30 years. The same author has contributed to the study of wine ferments[5] and their selection.[6] He shows that there are a number of species involved in vinification with very different conditions of growth, and that careful selection is necessary in order to get the best results. Duclaux[7] has reported upon the power of ferments and their activity. Bourquelot[8] has published a book on fermentation, and Fernbach[9] one on yeasts and their pure cultures. Wine making in hot countries is of interest to France on account of the vast areas in Algeria adapted to grape growing. Gayon[10] and Trabut[11] have given very valuable suggestions regarding wine making at high temperatures. Gayon recommends the use of the thermometer, glucometer, and microscope, and explains the use of each in the various stages of wine making. He recommends the use of small vats, favors pasteurization, and is opposed to the use of commercial yeasts. Marez[12] has contributed a note on the phosphatic food of alcoholic ferments; Marchand[13] on the beneficial action of phosphate of ammonia on musts, and on the temperature of fermentation[14] and wine making in hot countries;[15] and Müntz[16] on the refrigeration of must.

Loir and Duclaux[17] have given an account of palm wine, and Müntz and Rousseaux[18] have reported on wine making and on the fertilizer requirements of vineyards in Gironde. The latter is an elaborate treatise on viticulture discussing the fertilizers required, the chemical

[1] Bul. Min. Agr. France, 1896, p. 298.

[2] Ibid., p. 310.

[3] Ibid., p. 311.

[4] Les levures; Paris: Masson, 1896.

[5] Ann. Inst. Pasteur, 10 (1896), p. 1; Rev. Vit., 1896, Nos. 117, 127; Bul. Min. Agr. France, 1896, pp. 97, 428.

[6] Rapport au Bul. Min. Agr. France, 1892, 1893, 1894, 1895, 1896.

[7] Ann. Inst. Pasteur, 10 (1896), p. 129.

[8] Paris, 1896.

[9] Levain et levures. Biere et boissons fermenteés, 1896.

[10] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 235.

[11] Bul. Agr. Alger. et Tunis., 1896, No. 4, p. 75.

[12] Ibid., No. 20, p. 459.

[13] Ibid., Nos. 7, p. 157; 15, p. 351; 20, p. 459; 23, p. 541.

[14] Ibid., No. 6.

[15] Ibid., Nos. 17, 19, 20.

[16] Bul. Min. Agr. France, 1896, No. 3, p. 351.

[17] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 240.

[18] Bul. Min. Agr. France, 1896, Nos. 1, p. 49; 2, p. 217.

composition of various Bordeaux vines and their cultural requirements. In a note on the manufacture of hydromel Dufour[1] has shown that pure honey does not contain sufficient nitrogen for the most favorable development of the organisms of fermentation, and he recommends the addition of some nitrogenous substance, such as peptone, to aid in complete fermentation.

Fleurent[2] has studied quite extensively the composition of various cereals. He has found that gluten owes its adhesiveness to fibrin-gluten, the casein-gluten giving solidity and playing the rôle of an inert material in the mass. These conclusions agree with those already arrived at by Osborne and Voorhees.[3] The author has examined rye, maize, rice, barley, and buckwheat for these two substances. He has also given a chemical method for improving the baking value of wheat flour.[4] Whatever the amount of gluten in a flour the bread from it will be of better quality and more easily digested when the proportion of glutenin and gliadin in the gluten approaches the ratio of 1:3. If the proportion should be 1 to 4 the bread becomes soggy after baking and the loaf contains too much water. If the ratio should be 1:2 the flour works poorly and the bread is indigestible. A variation of 2 per cent either way from the typical composition is said to be readily detected by experts. He has found that the wheat embryo contains concentric deposits of gluten in which the proportion of glutenin and gliadin vary greatly. The results of investigations by Balland[5] on the quantity of gluten in flour accord with those given above by Fleurent. Different samples of flour having the same nitrogen content vary in their gluten content according to the method of grinding and bolting. The quantity of gluten, which is an index to the quality of flour, is not a sufficient guide to its nitrogen content nor its nutritive value. Balland[6] has reported on the chemical composition of the grain of indigenous and foreign varieties of maize and has also published a very important article[7] on varieties of wheat. He has given in the *Revue du Service de l'Intendance Militaire* the results of analyses of 300 varieties of wheat, from which he draws the following conclusions: There is no relation between the average weight of individual grains and the race or variety, soft, hard, and medium races having the same average weights. There is no general relation between the average weight of the individual grains and the weight of a bushel except that the latter decreases somewhat as the average weight decreases. Hard wheats as a rule contain the highest amount of fats. The amount of flour which

[1] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 235.

[2] Compt. Rend., 123 (1896), p. 327.

[3] Amer. Chem. Jour., 15 (1893) No. 6, pp. 392–471.

[4] Compt Rend., 213 (1896), p. 755.

[5] Ibid., p. 136.

[6] Compt. Rend., 122 (1896), p. 1004.

[7] Ibid., 123 (1896), p. 1303.

a wheat will produce depends upon the cellulose it contains. The soft wheats contain the greatest amounts of cellulose. The acid content varies from 0.02 to 0.04 per cent, and is independent of race, climate, or soil. Nitrogenous matter is most abundant in the hard wheats, especially in those having a rather high average weight. Wheats which are rich in starch are poor in fat. The composition of wheat is largely influenced by the climate, soil, and methods of culture. Hot climates are most favorable to the development of nitrogenous material, and dry, hot seasons will produce wheat rich in gluten. Large grains have a different composition from small ones, and white wheats contain less nitrogen than red or hard ones. The extremes in composition of 300 specimens of wheat are shown in the following table:

Extreme variation in composition of large and small grains of wheat.

	Average weight of 100 grains.	Water.	Protein.	Fat.	Cellulose.	Sugar and starch.	Ash.
	Gm.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Smallest	1.75	8.84	7.06	1.10	1.46	66.34	1.10
Largest	6.13	16.90	15.58	2.40	3.94	76.17	2.56

Loze[1] has given a review of the state of the starch industry of France. Heckel,[2] of the University of Marseilles, has made a study of the vegetable oils produced in the French colonies. Jumelle[3] has described the principal characteristics of the latex of Sakharè, a wild fig found in the forests of French Guinea, which furnishes a product intermediate between caoutchouc and gutta-percha. Caustier[4] has reported on the natural products of the French colonies and has urged the desirability of a permanent collective exhibition of the products of these colonies in Paris.

The foregoing summary indicates the nature and extent of the scientific activity of the investigators in agricultural botany in France during 1896. Their work touches many branches of the subject, although some lines of investigations are not keeping pace with others. From an agricultural standpoint the necessity is urgent for some means for controlling plant and animal parasites of cultivated plants. Attention should also be given to the improvement of cultivated varieties of all kinds. There is need for experiments with seeds with a view to modifying their character, hastening their development, and rendering them more resistant to their surroundings, as well as to determining the purity and value of those sold to consumers. It is to be hoped that the number of scientific stations where these subjects may be studied will be considerably increased.

[1] Rev. gén. sci. pur. et appl., 1896, No. 24, p. 1244.

[2] Ibid., No. 17, p. 750; Ann. Inst. Colonial Marseille.

[3] Assoc. Fr. Av. Sci., Congrès de Carthage, 1896, p. 181.

[4] Rev. gén. sci. pur. et appl., 1896, p. 113.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The insoluble carbohydrates of wheat, H. C. Sherman (*Jour. Amer. Chem. Soc., 19 (1897), No. 4, pp. 291–346*).—The author has devised a method for the estimation of different carbohydrates in foods and feeding stuffs which includes the determination of soluble carbohydrates, starch, pentosans, cellulose, and lignin and allied substances. The reported tests of the method were made principally with wheat bran. The different carbohydrates were isolated and identified. The analytical method is briefly described as follows: Five grams of substance (previously extracted with ether to remove the fat) is stirred with about 100 cc. of water for a few minutes, filtered, and washed. To the filtrate one-tenth its volume of 25 per cent hydrochloric acid is added and all heated in a flask with a reflux condenser for 2½ hours on a water bath or boiled for 30 minutes on a sand bath. The solution is clarified if necessary and the dextrose determined in an aliquot portion with Fehling's solution. The soluble carbohydrates are calculated as dextrin. The residue from the above filtrate is washed into a beaker with 100 cc. water, or more if the percentage of starch is high, heated to boiling, partially cooled, and inverted with malt extract until the starch disappears. It is then filtered and washed. The filtrate is treated as before with hydrochloric acid and the dextrose determined with Fehling's solution and calculated to starch. The residue from the above filtrate is boiled for 30 minutes with 1¼ per cent sulphuric acid, filtered and washed with water and alcohol. To the filtrate sufficient sulphuric acid is added to make 2 per cent and all gently boiled with a reflux condenser for 6 hours. The reducing power is determined and the result first calculated to pentoses and then to free pentosans. The residue from the filtrate is dried and weighed, correction being introduced for protein and ash (which must be determined in a duplicate sample). The dry material is chlorinated according to Cross and Bevan's[1] method and extracted with alcohol. The residue is dried and weighed. The loss of weight (corrected for ash and protein) equals the lignin and allied substances. The residue (less protein and ash if present) equals cellulose. The author remarks that lignin chlorid has not been obtained before from other sources than commercial fibers. He calls attention to the fact that cellulose and lignin

[1] Cellulose, p. 135.

are "used to designate, respectively, the carbohydrates and more or less condensed portions of the fiber," and not to represent definite chemical compounds.

The food (bran) and feces from a digestion experiment with a steer made at the Maryland Station[1] were examined by the author, using the above method. The amounts of the different carbohydrates of the food and feces and their coëfficients of digestibility are given in the following table:

Coëfficients of digestibility of carbohydrates of bran by a steer.

	Soluble carbohydrates.	Starch.	Free pentosans.	Cellulose.	Lignin and allied substances.	Total carbohydrates.	Undetermined.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In food	7.2	17.7	17.5	8.5	11.6	62.5	4.04
In feces	.7	....	18.7	20.2	23.2	62.8	2.60
Coëfficients of digestibility	96.9	100.0	66.2	24.8	36.7	....	....

For the sake of comparison the coëfficients of digestibility of bran obtained at the Maryland Station[1] are given in the following table:

Coëfficients of digestibility of bran by a steer.

	Nitrogen-free extract.	Crude fiber.	Total carbohydrates.	Protein.	Ether extract.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In food	55.59	10.96	66.55	20.49	6.92	6.05
In feces	41.93	23.47	65.40	11.04	12.52	11.04
Coëfficients of digestibility	76.08	32.21	....	82.96	42.73	42.21

"We see from the above that the digestibilities of the insoluble carbohydrates range from 25 to 100 per cent. The nitrogen-free extract with a mean digestibility of 76 per cent is composed of substances whose percentage digestibilities vary from 100 to less than 40. Even in the case of the crude fiber the digestibility of one of the constituents considerably exceeds that of the other. It must be borne in mind in this connection that the group of lignin and similar substances is divided by the current methods, part being included in the nitrogen-free extract and part in the crude fiber."

Methods of analysis of barnyard manure, J. H. VOGEL (*Ber. Vers. Stat. deut. landw. Ges. 1894–'95, pp. 11–14, 22–25, figs. 10*).—Samples of from 5 to 10 kg. are usually taken and kept in rubber sacks until prepared for analysis. For the latter purpose the material is finely divided by means of a chopping knife and thoroughly mixed. For the determination of nitrogen 100 gm. of the finely divided manure is placed in a wide-necked $1\frac{1}{4}$ liter flask, 125 to 140 cc. (according to the moisture content of the manure) of concentrated sulphuric acid added and the whole allowed to stand over night. Eight to nine grams of mercury is then added and the digestion commenced, the flame being kept quite low at first to prevent foaming. The digestion is usually complete in from 4 to 5 hours. The contents of the flask are then taken up in water, thoroughly mixed, and the volume made up to

[1] Maryland Sta. Bul. 41 (E. S. R., 8, p. 1004).

1,000 cc. One hundred cubic centimeters of this solution, corresponding to 10 gm. of the original substance, is distilled for the determination of nitrogen.

For the determination of ammoniacal nitrogen, 100 gm. of the manure is shaken up with 4 or 5 times its weight of water in a wide-necked liter flask and allowed to stand several hours. The solution is then made up to 1,000 cc. and 100 cc. is withdrawn for distillation of the ammonia, which is set free by the addition of 2 to 3 gm. of calcined magnesia.

For the determination of nitric nitrogen, two methods were tested, namely, the zinc-iron method and Pfeiffer's[1] method. The first of these methods gave quite discordant results, in every case much lower than those obtained by Pfeiffer's method. The latter, however, is somewhat complicated and time-consuming, and it is suggested that it may be modified to advantage. Instead of using the Lintner pressure flask, it is suggested that the material be heated in an oven in a sealed potash glass tube.

The total phosphoric acid is determined in 50 cc. of the Kjeldahl solution by neutralizing with ammonia until a permanent precipitate begins to form and adding 50 cc. each of nitric acid (sp. gr. 1.2) and molybdic solution; the remainder of the operation being conducted in the usual way. The water-soluble phosphoric acid is determined in the usual way in an aliquot of the solution prepared for the determination of ammoniacal nitrogen.

The method of determining potash has already been described in the Record.[2] For the determination of dry matter 3,000 grams of the manure is weighed out on a balance capable of weighing 25 kilograms and sensitive to 0.1 gram. The sample is spread out in thin layers and dried in an air bath at a temperature of from 60 to 65°, the material being stirred once after the first 2 or 3 hours. The drying is usually completed after 48 hours, and the material is then spread out in dishes and exposed to the air for 24 hours. This dry-air substance is then ground and 3 gm. taken for the determination of the absolute moisture.

Analysis of limestone, F. SCHEIDING (*Chem. Ztg., 21* (*1897*), *No. 8, pp. 54, 55*).—The author criticises a method recently described in this journal[3] and proposes one which he claims to be more accurate and simple. The hydrochloric acid solution is oxidized with bromin water and the iron and aluminum precipitated with ammonium hydrate. The precipitate is ignited, dissolved in hydrochloric acid, which is subsequently almost completely removed by evaporation. The solution is then nearly neutralized with ammonia, and when cold an equal volume of strong acetic acid is added, a solution of about 0.1 gm. of nitroso-β-naphthol in 30 cc. of hot 50 per cent acetic acid is stirred in, and the solution allowed to stand for a few hours to insure the complete precipi-

[1] Landw. Vers. Stat., 46 (1895), p. 1 (E. S. R., 7, pp. 269, 552).
[2] Ibid., 47 (1896), p. 97 (E. S. R., 8, p. 457).
[3] Chem. Ztg., 20 (1896), p. 1004.

tation of the iron. Lime is determined in the usual way by precipitation with ammonium oxalate after oxidation with bromin water. To an aliquot part of the original solution sufficient ammonium oxalate is added to precipitate the lime, which is allowed to settle over night. The solution is then made up to a given volume and an aliquot part taken, without filtration, for the determination of magnesia in the usual way.—J. T. ANDERSON.

Observations on the oxidation of nitrogen gas, Lord RAYLEIGH (*Jour. Chem. Soc., 1897, Feb., pp. 181–186, fig. 1*).—The apparatus and method used in the oxidation of the nitrogen of the air by means of the electric spark and the absorption under normal pressure of the product by an alkaline solution are briefly described.

Observations on certain properties of the oxydase of wines, BOUFFARD (*Compt. Rend., 124 (1897), No. 13, pp. 706–708*).

On the nonidentity of lipases of different origin, HANRIOT (*Compt. Rend., 124 (1897), No. 14, pp. 778–781*).

The action of soluble [enzymic] ferments on starches of different origin, W. E. STONE (*Ann. Agron., 23 (1897), No. 4, pp. 169–182*).—Translated from Bulletin 34 of this office (E. S. R., 8, p. 662) by E. Gain.

The determination of carbon dioxid in carbonates, J. H. VOGEL (*Ber. Vers. Stat. deut. landw. Ges. 1894–'95, pp. 16–19, fig. 1*).—An improved Finkener apparatus for the determination of carbon dioxid in limestone, marls, etc., is described at some length. No rubber connections are used in the apparatus proper and provision is made for a constant current of purified air through the apparatus. The carbon dioxid is absorbed by 50 per cent potash solution.

On the separation of chlorin and bromin, H. BAUBIGNY and P. RIVALS (*Compt. Rend., 124 (1897), No. 16, pp. 859–862*).

Observations on the unification of methods of analysis, A. PAGNOUL (*Ann. Agron., 22 (1896), No. 12, pp. 580, 581*).—As a general proposition, the efforts toward unification of methods are opposed. It is deemed unwise to attempt to impose fixed and arbitrary rules in the application of a science essentially mobile and progressive. In certain lines, as the analysis of fertilizers, the adoption of uniform methods has been very useful. The prescribed methods have been consulted by all with profit, but analysts have continued the efforts to modify the methods so that they will be more rapid and simple and less expensive. Freedom of action on the part of different chemists in these respects should not be discouraged or interfered with. A method may prove very good in the hands of one chemist and very unsatisfactory in the hands of another. "*En résumé, éclairons-nous, mais ne nous enchaînons pas.*"

BOTANY.

Development and transpiration of barley under the influence of different degrees of humidity and nutrition in the culture media, R. R. SCHROEDER (*Izvyestiya Moskovskagho Selbskokhozyaistvennago Instituta. Ann. Inst. Agron. Moscou, 2 (1896), No. 2, pp. 188–226*).—The author compares the effects produced on barley in sand cultures by changes in the humidity of the culture media with the effect resulting from changes in the concentration of the nutritive solution. The humidity of the sand in different cultures was 20, 40, and 80 per cent of saturation. The nutritive solution used was made according to the following formula: Monopotassium phosphate 6.2 gm., potassium chlorid 1.71 gm., magnesium sulphate 2.19 gm., and calcium nitrate 29.9 gm., and it was used in concentrations varying from 1 to 12 per cent.

From the experiments the following conclusions were drawn:

The development of the adventitious stalks was more pronounced the greater the concentration of the salts for the same degree of humidity, and for the same quantity of salts the duration of the period of growth was prolonged in proportion to the amount of water at the plant's disposal. The duration of the period of vegetation was also in proportion to the amount of salts contained in the soil.

It was observed that the greatest size of the stalk, shoot, and of the ears corresponded to the maximum of humidity and concentration of the salts in the soil. It was also observed that the yield of dry matter of the whole plant and each of its parts increased with the increase in the humidity and the nutritive material in the medium.

The yield in straw and grain was twice as great under the highest degree of humidity and the greatest nutritive content of the medium, as under opposite conditions.

The development of the root system increased with the diminution of the humidity and the concentration of the nutrient solution, while the development of the stalks and leaves increased with the augmentation of concentration. The transpiration of the plants was proportional to the humidity and the quantity of nutritive material present in the medium.

The quantity of water evaporated, referred to a unit of dry matter, increased with the augmentation of the concentration of the medium until the latter reached a certain limit (4 per cent), beyond which it fell.

The percentage of water evaporated was in direct ratio to the quantity contained in the soil.

The average amount of water transpired by barley to form 1 gm. of dry matter was 475 gm.

The amount of water transpired in 24 hours by a surface of 100 sq. cm. covered with leaves was 7.2 gm., while a free water surface evaporated 16.7 gm.

Comparing the data of the last two paragraphs, the author concludes that barley forms on an average 0.015 gm. of dry matter for 100 sq. cm. of leaved surface, so that 100 sq. cm. of the tissue of the leaves (with a surface of 200 sq. cm.) furnishes 0.030 gm. of dry substance in 24 hours.—P. FIREMAN.

The combined influence of light and medium on the development of fungi, A. LENDNER (*Ann. sci. nat. Bot., ser. 8, 3 (1896), No. 1, pp. 1–64, figs. 7*).—A series of experiments with Mucor, Thamnidium, Rhizopus, Pilobolus, Botrytis, Amblyosporium, and Sterigmatocystis grown upon different media in darkness and under red, yellow, blue, violet, and clear glass are reported. The culture media used were—for the liquid solutions Cohn's modified solution, Raulin's, Van Tieghem's, Schmitz', a solution lacking lime, and an infusion of horse dung. The solid media were gelatin-peptone and Van Tieghem's solution, horse dung infusion, and Raulin's solution, to each of which 2 per cent agar-agar was added.

The detailed account of germination and growth and general conclusions from the more important results are given. The influence of light upon spore-bearing fungi grown upon solid media is shown in the case of the Mucors all developing their sporangia under the different conditions. There was some difference in the growth of the mycelium, it being twice as long in darkness, red and yellow light as in other cases. In the liquid media, the action varied with nearly every species. *Rhizopus nigricans* was retarded 2 days in maturing its sporangia. *Mucor racemosus* developed its spores in light but not in darkness and only rarely in red and yellow light. *Mucor flavidus* behaved differently in each culture solution. *Thamnidium elegans* and *Mucor mucedo* developed in every case but their sporangia were most abundant in darkness, red, and yellow light.

The influence of light upon conidia-bearing fungi was investigated and it was found that in alternating day and night all produced their conidia in about the same time without being influenced by light or medium. Continuous illumination produced effects which varied with the different species. *Botrytis cinerea*, *Sterigmatocystis nigra*, and *S. lutea* produced their conidia most abundantly under the red and yellow light. Darkness and too great a degree of illumination were alike unfavorable for their best growth. For other species the illumination did not seem in any way to influence their development.

In general the development of fungi is dependent upon nutrition, the action of light being of secondary importance.

Experiments on leguminous root tubercles, W. W. DODSON (*Louisiana Stas. Bul. 46, 2d ser., pp. 88–99*).—A series of experiments were made to ascertain the influence on leguminous root tubercles of deep and shallow planting, the depth to which the nitrifying organisms penetrate, and the results of transferring organisms from one host to another.

Cowpeas were planted at depths of 1, 2, 3, 4, 5, and 6 in. The best root formation and the greatest number of tubercles were obtained with seeds planted 2 and 3 in. deep.

After taking precautions to avoid infection from other sources, a number of pots were filled with soil taken from 1, 2, and 3 ft. below the surface and Lima beans, New Era cowpeas, peanuts, and white lupines grown in it. Only on the plants grown in soil taken at the depth of 1 ft. were tubercles formed, but they were not so numerous as from surface inoculation.

The experiment in transferring the organisms from one host to another indicated that each plant, or at most each genus of plants, supports a specific organism capable of developing root tubercles.

First report on the flora of Wyoming, A. NELSON (*Wyoming Sta. Rpt. 1896, Appen., pp. 47–218, figs. 3, map 1*).—A reprint of Bulletin 28 of the station (E. S. R., 8, p. 291).

New species of Kansas fungi, J. B. ELLIS and E. BARTHOLOMEW (*Erythea, 5 (1897), No. 4, pp. 47–51*).—Descriptions are given of 18 new species.

Concerning the systematic description and geographic distribution of the Pomaceæ, V. FOLGNER (*Oesterr. Bot. Ztschr., 47 (1897), No. 4, pp. 117-125, pl. 1*).

Concerning some leaf structures, CATHERINE KOMAROFF (*Bul. Herb. Boissier, 5 (1897), No. 4, pp. 221-251, figs. 13*).—Anatomical studies of the structure of the petioles of the leaves of several species of poplar, willow, and other plants are given.

Concerning the tubers and roots of Cyclamen, F. HILDEBRAND (*Bul. Herb. Boissier, 5 (1897), No. 4, pp. 252-257*).

Concerning cytoplasm structures, nuclear and cell division, E. STRASBURGER (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 375-405, figs. 2*).

Notes on underground runners, IDA A. KELLER (*Proc. Phil. Acad. Nat. Sci., 1897, I, pp. 161-165, pl. 1*).

Structure and physiology of the cell, M. M. TSWETT (*Arch. Sci. Phys. et Nat. Sci., 1896; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 134*).

Nuclear division and fruiting of Fucus, E. STRASBURGER (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 351-374, pls. 2*).

Nuclear division in the pollen mother cells of some decotyledons and monocotyledons, D. M. MOTTIER (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 169-204, pls. 3*).

Nuclear and cell division in the Sphacellariaceæ, W. T. SWINGLE (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 297-350, pls. 2*).

Nuclear division and fruiting in Basidiobolus ranorum, D. G. FAIRCHILD (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 285-296, pls. 2*).

Nuclear division and cell formation in asci, R. A. HARPER (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 250-284, pls. 2*).

Nuclear division in Chara fragilis, B. DEBSKI (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 227-249, pls. 2*).

Nuclear division in the pollen mother cells of Hemerocallis fulva, H. O. JUEL (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 205-226, pls. 3*).

Effect of different degrees of shade on plant growth, E. GUIGNIER (*Rev. Eaux et Forêt, ser. 3, 1 (1897), No. 7, pp. 193-206*).—The author distinguishes between three degrees of shading and discusses the effect of each upon plant growth.

On the assimilatory energy of the blue and violet rays of the spectrum, F. G. KOHL (*Ber. deut. bot. Ges., 15 (1897) No. 2, pp. 111-124, fig. 1*).

Concerning the physiology of the leptom in angiosperms, F. CZAPEK (*Ber. deut. bot. Ges., 15 (1897) No. 2, pp. 124-131*).

Alternation of generations (*Gard. Chron., ser. 3, 21 (1897), No. 539, pp. 272, 273, figs. 2*).

The nutrition of plants, T. F. HANAUSEK (*Wiener illus. Gart. Ztg., 22 (1897), No. 4, pp. 117-126*).—An address in which the subject of plant nutrition is reviewed and the present opinions briefly outlined.

Formation and dissolution of hemicellulose, J. GRÜSS (*Biblotheca Botanica 1896, No. 39, pp. 15, pl. 1; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 145*).

Endoderm and pericycle in Trifolium, S. BELLI (*Mem. Accad. Sci. Torino, 46 (1896), pp. 353-441, pls. 6; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 136*).—A study was made of Trifolium and a general criticism is given of van Tieghem's stele theory.

Concerning the deposition of silica by plants, E. KUSTER (*Ber. deut. bot. Ges., 15 (1897), No. 2, pp. 136-138*).

Studies on the hypertrophy produced by Rœstelia lacerata on the leaves, branches, etc., of Cratægus oxyacantha, V. PORCELLI (*Riv. pat. Veg., 5 (1896), No. 5-8, pp. 245-252, pl. 1*).

Hypertrophy and anomalous nuclear division induced by plant parasites, F. CAVARA (*Riv. pat. Veg., 5 (1896), No. 5-8, pp. 238-244, figs. 3*).

Concerning the origin of the karyokinetic spindle in Equisetum, W. J. V. OSTERHOUT (*Jahrb. wiss. Bot., 30 (1897), No. 2-3, pp. 159-168, pls. 2*).

Encapsuling of starch grains, L. BUSCALIONI (*Malpighia, 10 (1896), pp. 479-489, pl. 1*).—The author reports finding a rapidly forming capsule around the starch grains in the third layer of the integument of *Vicia narbonensis* and other legumes, as well as *Eschscholtzia californica*.

FERMENTATION—BACTERIOLOGY.

Fermentation, F. T. BIOLETTI (*California Sta. Rpt. Viticult. Work, 1887–'93, pp. 379–421, figs. 6*).—The author reviews the general principles of fermentation and discusses the subject from an historical standpoint. Notes are given on the origin of yeasts, conditions of fermentation, purification and selection of yeasts, acidity, nitrogen, aëration, influence of temperature, and refrigerators or cooling machines.

Experiments were made with pure and selected yeasts as well as with other fungi, particularly *Botrytis cinerea*, which is reported upon at length in another place (p. 959). The principal yeast experimented with was Johannisberg. These experiments were supplemented with yeasts from various other sources. In general there seems to be no indication of the production of a greater amount of alcohol by the use of pure ferments. In fact, some of the wines seem to contain less alcohol than those fermented by the ordinary methods of production. However, owing to the difficulties in obtaining exact data the author considers that it would be unwise to draw conclusions without a number of further trials. In every experiment conducted at Berkeley the wines fermented with the addition of yeasts from cultures were cleaner and fresher tasting than those allowed to ferment with whatever yeasts happened to exist on the grapes. The difference, while sometimes slight at first, increased with the age of the wine. The promptness with which fermentation begins and the short time in which it is finished when yeasts are introduced prevents the development of any large number of injurious ferments, and the rapid clearing makes it possible to rack the wine early and thus remove from it the influence of many other injurious microörganisms.

A summary of conclusions is given which shows the merits of pure yeasts in that they produce a quicker fermentation, a more prompt clearing, a cleaner taste due to the overslaughing of injurious ferments, and probably an improvement in flavor and bouquet. According to the author, the indications are that the use of a pure California yeast would be preferable to any other. This subject is to be further investigated.

Fermentation at high temperatures with the addition of various substances was investigated to some extent. Defective fermentation in a hot climate is well known, and various substances are added to wine to render the must unsuitable for the growth of injurious organisms, to increase the development of the yeast by making must more favorable for its growth, and to keep the temperature of the must below the optimum for injurious ferments. The substances most used for this purpose are gypsum, tartaric acid, unripe grapes, ammonium phosphate, peptone, sulphurous acid, sulphites, and asaprol. The effect of each of these substances on fermentation and upon the quality of the wine is given.

A brief account is given of inconclusive experiments made with a patented apparatus for use in closed fermentations.

The color of grapes and its effect on wines was investigated. California wines in general have an abundance of color, although there are some varieties lacking in this respect. As the bulk of the wine comes from grapes having little color it is important that those possessing color should be used economically, and various experiments were conducted with this in view. It was found that the most effective way of utilizing coloring grapes is to ferment them separately and make the blend immediately after pressing. If the grapes are fermented together the pomace takes up too much of the color. If blending is deferred any length of time after pressing there is also a loss. The amount of a certain wine to be added to another to secure a certain depth of color can not be stated, but must be determined experimentally according to the age and character of the wines used.

The use of asaprol, which has been recommended as a means of preventing too high temperatures during fermentation, is separately reported upon at considerable length. This substance, which is said to be a coal-tar product, is a light brownish pink powder the chemical composition of which is not known. It is supposed to act as a mild antiseptic, reducing the vigor of the yeast without permanently injuring it or preventing it from thoroughly eliminating the sugar. The experiments tend to show "that its action is greater upon alcoholic yeasts than upon other organisms and ferments in the must. Thus, while preventing undue heating, by hampering the development of the yeast, it allows other organisms to take possession of the wine, causing, in another way, the very trouble it is intended to prevent. It is very doubtful, then, if asaprol can be used with any more advantage than sulphur, and as the ends intended to be attained by the use of these antiseptics can be easily compassed by purely mechanical means, there remains no excuse or need for their use."

Botrytis cinerea, F. T. BIOLETTI (*California Sta. Rpt. Viticult. Work, 1887–'93, pp. 451–453, pl. 1*).—Notes are given on some investigations which were conducted with this fungus, which is believed to be beneficial to wine. It is illustrated and sufficiently characterized to distinguish it from *Penicillium glaucum* and *Aspergillus niger*, both of which are frequently found in the processes of wine making and are considered detrimental. The experiments conducted with Botrytis seemed to indicate that the small quantity of the mold which appears about vintage time upon the surface of the grapes has no appreciable effect, but if the grapes are badly attacked the resulting wine is likely to have a sherry taste, probably on account of the preliminary oxidation of the must through the partial disintegration of the skin of the grapes.

Directions are given for the prevention of the growth of Penicillium and Aspergillus.

The nitric ferment, A. STUTZER and R. HARTLEB (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 7–8, pp. 161–177*).

Concerning the duration of the vitality of dried yeasts, H. WILL (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 1, pp. 17–21*).

Concerning the life history of the Saccharomycetes, A. BERLESE (*Riv. pat. Veg., 5 (1896), No. 5–8, pp. 211–237, figs. 8*).

On the origin of the Saccharomycetes, A. KLÖCKER and H. SCHIÖNNING (*Meddel Carlsberg Lab., 1896, pp. 85–144; French résumé, pp. 36–68*).

Studies on Amylomyces rouxii and other mold ferments of starch, J. SANGUINETI (*Ann. Inst. Pasteur, 11 (1897), No. 3, pp. 264–276*).

Physiological studies with a new mold, Eurotiopsis gayoni, J. LABORDE (*Ann. Inst. Pasteur, 11 (1897), No. 1, pp. 1–43*).

On the soluble oxidizing ferment of muddy wine (casse des vins), P. CAZENEUVE (*Compt. Rend., 124 (1897), No. 4, pp. 781, 782; Bul. Soc. Chim. Paris, 17–18 (1897), No. 10, pp. 529–535*).

ZOÖLOGY.

Biennial Report of the Biological Experiment Station, 1895–'96, S. A. FORBES (*Univ. Ill., Biolog. Expt. Sta. Rpt. 1895–'96, pp. 35, pls. 20*).—A description of the station, its object and methods, and a very brief summary of the results of its work are given. The essential objects of the station are described as follows:

"It is the general object of our biological station to study the forms of life, both animal and vegetable, in all of their stages, of a great river system, as represented in carefully selected typical localities. This study must include their distinguishing characters; their classification and variations; their local and general distribution and abundance; their behavior, characteristics, and life histories; their mutual relationships and interactions as living associates; and the interactions likewise between them and the inanimate forms of matter and of energy in the midst of which they live. We are, in short, to do what is possible to us to unravel and to elucidate in general and in detail the system of aquatic life in a considerable district of interior North America. . . . The principal methods of the biological station are those of field and laboratory observation and record, collection, preservation, qualitative and quantitative determination, description, illustration, generalization, experiment, induction, and report."

The figures consist of maps and half-tone reproductions of photographs, illustrating the laboratory and some of the localities where the work is done.

Revision of the shrews of the American genera Blarina and Notiosorex, C. H. MERRIAM (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 10, pp. 5–34, pls. 2, fig. 1*).—This consists of technical descriptions and synoptical keys to the species of these two genera, with remarks upon their relationships and geographical distribution. Twenty species and subspecies of Blarina and 2 of Notiosorex are recognized. Thirteen forms are described as new.

The long-tailed shrews of the eastern United States, G. S. MILLER (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 10, pp. 35–56*).—This consists of critical notes and technical descriptions of 7 species of Sorex.

Synopsis of the American shrews of the genus Sorex, C. H. MERRIAM (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 10, pp. 57–98, pls. 10*).—This paper furnishes descriptions on a common plan of the principal types of American shrews. Brief descriptions and notes on the distribution of 41 species and subspecies are given, 34 from that part of the continent north of Mexico, and 7 from Mexico and Guatemala. Twenty forms are described as new.

Synopsis of the weasels of North America, C. H. MERRIAM (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 11, pp. 44, pls.*

5, figs, 16.)—Critical notes and descriptions are given of the American forms of the subgenera Putorius and Ictis, and a table showing the average cranial measurements of the 18 species of North American weasels.

Genera and subgenera of voles and lemmings, G. S. MILLER (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 12, pp. 84, pls. 3, figs. 4*).—The author gives an account of the geographical distribution, habits, nomenclature, history of former classifications, characters upon which the present classification of the subgenera Microtus is based, and descriptions of living and extinct genera and subgenera.

North American birds, H. NEHRLING (*Milwaukee, Wis.: G. Brumder, 1894–'96, vol. 1, pp. 371; vol. 2, pp. 452, pls. 36*).

The birds of Nebraska, L. BRUNER (*Nebraska State Hort. Soc. Rpt. 1896, pp. 98–178, figs. 51*).—Some notes on Nebraska birds and a list of the species and subspecies found in the State, with notes on their distribution, food habits, etc., corrected to April, 1896.

The forest birds as enemies of forest insects, E. IRMER (*Zool. Garten, 37 (1896), pp. 299–309*).

Crop and gizzard contents of some gallinaceous birds, C. LOOS (*Monat. deut. Ver. Schutze Vögeln, 21 (1896), pp. 16–18, 52–56*).

Feathered vermin in the Pentland Hills, R. GODFREY (*Sci. Gos., 3 (1897), No. 83, pp. 241–243*).—Under this designation the author includes the kestrel, merlin, sparrow hawk, long-eared owl, magpie, crow, and jackdaw.

Materials for statistics on the injuriousness or usefulness of certain species of birds, E. RZEHAK (*Monat. deut. Ver. Schutze Vögeln, 21 (1896), pp. 14–16*).

Sharp eyes: A rambler's calendar of 52 weeks among insects, birds, and flowers, W. H. GIBSON (*New York: Harper & Bros., 1896, pp. 322, ill.*).

Manual of North American birds, R. RIDGWAY (*Philadelphia: Lippincott, 1896, 2d ed., pp. 653, figs. 464*).

METEOROLOGY.

Annual summary of meteorological observations in Colorado in 1896, W. L. MOORE and F. L. BRANDENBURG (*U. S. Dept. Agr., Colorado Section Climate and Crop Service of the Weather Bureau, Annual Summary, 1896, pp. 12, charts 3*).—Summaries are given of observations on temperature, precipitation, cloudiness, etc., compiled from data collected at 60 stations in Colorado during 1896. The maximum temperature observed was 107° F. at Lamar June 14 and August 9, and at Delta June 15. The minimum temperature was −29° F. at Steamboat Springs February 4 and Gunnison February 6. The average precipitation was 15.07 in., or 0.81 in. below the normal. "The greatest precipitation occurred at Ruby, where the record for 8 months gave 41.69 in., and the least, 3.5 in., at Garnett." The greatest snowfall, 417 in. in 8 months, occurred at Ruby.

"On an average 160 days, or 44 per cent, were clear; 134, or 37 per cent, partly cloudy; and 72, or 19 per cent, cloudy. The average number of rainy days (days with 0.01 in. or more precipitation) was 61; the greatest number, 79, occurring in the mountain districts, and the least, 39 days, in the Arkansas Valley. The prevailing wind during the year was from the west. The average sunshine at Denver for the year was 69 per cent of the possible. The yearly average is 68 per cent. The total wind movement for the year at Denver was 71,468 miles, and Pueblo, 67,062 miles, making the average hourly velocity 8.1 and 7.6 miles per hour, respectively."

Meteorological observations at the Massachusetts Hatch Station, October–December, 1896, L. METCALF and J. L. BARTLETT (*Massachusetts Hatch Sta. Met. Buls. 94–96, pp. 4 each*).—These bulletins give the usual summaries of observations at the meteorological observatory of the station. The December number gives in addition a summary for 1896, which is as follows:

Pressure[1] (inches).—Maximum, 30.94, Dec. 27; minimum, 28.72, February 6. *Air temperature*[2] (degrees F.).—Maximum, 97, August 12; minimum, —14, February 17; mean of means of maximum and minimum, 47; mean sensible (wet bulb), 44; maximum daily range, 47, April 16; minimum daily range, 3, October 5. *Humidity.*—Mean dew point, 39.9; mean force of vapor, 0.422; mean relative humidity, 76.9. *Precipitation.*—Total rainfall or melted snow, 39.66 in.; number of days on which 0.01 in. or more of rain or melted snow fell, 108; total snowfall in inches, 44. *Weather.*—Mean cloudiness observed, 49 per cent; total cloudiness recorded by sun thermometer, 2,018 hours, or 46 per cent; number of clear days, 132; number of fair days, 102; number of cloudy days, 132. *Wind.*—Prevailing direction, W. SW.; N., 10 per cent; S., 10 per cent; S. SW., 10 per cent; W., 10 per cent; SW., 7 per cent; other directions, 53 per cent; total movement, 59,198 miles; maximum daily movement, 620 miles, March 4; minimum daily movement, 14 miles, February 1; mean daily movement, 161.7 miles; mean hourly velocity, 6.7 miles; maximum pressure per square foot, 251 lbs., 71 miles per hour on May 18. *Dates of frosts.*—Last, May 1 (May 20 in lowlands); first, September 24 (September 21 in lowlands). *Dates of snow.*—Last, April 7; first, November 14.

Meteorological summary for Ohio, 1896, C. A. PATTON (*Ohio Sta. Bul. 74, pp. 247–260*).—Notes on the weather, and tabulated daily and monthly summaries of observations at the station on temperature, precipitation, cloudiness, direction of the wind, etc., are given; and for comparison similar data for previous years and for other parts of the State are added. The following is a summary of results:

Summary of meteorological observations.

	For the experiment station.				For the State.			
	1896.		For 9 years.		1896.		For 14 years.	
Temperature (° F.):								
Mean	49.6		48.9		51.8		50.59	
Highest	93	(Aug. 9)	99	(Aug. 8, '91)	103	(Apr. 17)	108	(July 18, '87)
Lowest	—6	(Feb. 19)	—20	(Jan. 20, '92)	—18	(Feb. 9, 10, 11)	—34	(Jan. 25, '84)
Range	99		102.4		121		122.1	
Mean daily range	19		20.2		20		20.5	
Greatest daily range.	43	(May 8)	55	(Oct. 6, '95)	53	(Mar. 25)	60	(Oct. 19, '94)
Least daily range	3	(Jan. 10, Mar. 8)	1	(Nov. 27, '95)	0	(Feb. 6, 13)	0	*a* (Feb. 6, 7, 13)
Clear days	130		118		118		117.2	
Fair days	106		124		130		123.7	
Cloudy days	130		117		118		125.4	
Days rain fell	134		125		124		124.7	
Rainfall (in.):								
Total	38.47		39.25		39.58		37.95	
Greatest monthly	8.05 (July)		8.05 (July, '96)					
Least monthly	0.71 (Oct.)		0.37 (Oct., '92)					
Mean daily					0.12		0.104	
Direction of wind	SW.		S. SW.		SW.		SW.	

a February 7, 1895; 6 and 13, 1896.

[1] Reduced to freezing and sea level. The instruments are 2,735 ft. above sea level.

[2] Temperature in ground shelter 51 ft. below level of other instruments.

Climate of Oklahoma, G. E. MORROW (*Oklahoma Sta. Bul. 22, pp. 3, 4, 7, 8*).—Tables are given which show the rainfall at 21 stations in Oklahoma and Indian Territories in 1896, at 12 stations in Oklahoma Territory during 8 years (1889–'96), and at Elreno and Oklahoma City during each month for 6 years (1891–'96), and the monthly mean temperature of Oklahoma Territory for the same period (1891–'96).

"The year 1896 was somewhat exceptional in Oklahoma so far as the climatic conditions were concerned. The average mean temperature, 61.7°, as shown by reports from 21 stations, including some in the Indian Territory, was higher than in 1895. No report was made of a temperature below zero at any time during the year, and in but two cases was the minimum below 6°. The maximum temperature was unusually high, every station reporting a maximum ranging from 104 to 115°. With one exception the highest temperature was at some date between August 1 and 20. With one exception each station reported a maximum of over 100° in July, as did all but two in September.

"The rainfall was below the average in most parts of the Territory. The average as reported by 17 stations in Oklahoma was 24.69 in., ranging from 15.04 at Beav r in the far northwest, to 31.71 at Guthrie and 31.40 at Stillwater. In many cases the rainfall was not distributed well throughout the year. Thus, at Stillwater, 11.69 in. fell in 31 days from June 21 to July 21. A still more striking case is that of Burnett, where, out of a total rainfall of 26.08 in. for the year, 6.02 in. fell in one day in May. At Oklahoma City the rainfall was the least for any year of the last six and 10.74 in. less than the average for the preceding 5 years. . . . Records at Fort Reno for 14 years (not quite complete for some of the earlier years) give an average rainfall of 27.67 in. per year. For the first 7 years the average was 29.93 in., for the last 7 years 25.41 in., or a difference of over 4½ in. per year in the two periods. . . .

"A maximum temperature of 100° or more may be expected in almost any part of the Territory in July, August or, possibly, September. Usually the time during which extreme high temperature continues is short. A minimum temperature of 12° or even 20° below zero is possible, but unusual. The mean average temperature for the year is from perhaps 59 to 62°.

"With occasional marked exceptions the annual rainfall decreases from the east to the west and, in not so marked a degree, from the south to the north. . . .

"For 1896 7 stations lying east of 97° 30′ west longitude showed an average rainfall of almost 27 in., while 7 lying west of this line showed an average of about 24.50 in. . . .

"In general the heaviest rainfall is during the months from May to August, inclusive. In 1896 only 2 stations in Oklahoma reported a rainfall over 2 in. for either of the first months of the year."

The climate of Utah, J. DRYDEN (*Utah Sta. Bul. 47, pp. 58, charts 4, figs 8*).—A summary is given of observations on temperature, pressure, humidity, precipitation, etc., at 12 stations in the State during 1896, and the climate of the State as indicated by the averages of observations during the 5 years ending with 1895 is discussed.

The annual summary for 1896 is as follows: Mean annual temperature, 46.9° F.; mean daily range, 22°; annual range, 108°; highest, 97°; lowest, —11°; highest sensible, 75°; mean humidity, 54; mean dew-point, 45; air pressure 24.963 in.; total precipitation, 16.15 in.; last killing frost, May 18; first killing frost, October 10.

The principal features of the climate of Utah are, of course, the comparatively high temperatures with limited rainfall, but it is shown that although "the air temperature in this dry climate is considerably higher

than that of the humid States of the East, the sensible temperature, the temperature actually felt by the human body, is so much lower in the arid region that it may be positively pleasant in the mountain valleys and at the same time decidedly oppressive, often fatally so, in the humid East."

It has been claimed that the rainfall is increasing in Utah and other arid States under the influence of the cultivation of the soil and the growth of forests, but an examination of meteorological data bearing on this point reveals no ground for belief that rainfall is either increasing or decreasing.

Meteorological summary for 1896, H. J. PATTERSON (*Maryland Sta. Rpt. 1896, p. 221*).—A monthly summary of observations at the station on precipitation and temperature is given. The annual precipitation was 30.27 in.; the maximum temperature 98° F. (August 6, 7, and 9), minimum 7 (February 22 and December 28), and mean 54.3.

Meteorological observations, L. METCALF and J. L. BARTLETT (*Massachusetts Hatch Sta. Met. Buls. 97–99, pp. 4 each*).—The usual summary of observations at the meteorological observatory of the station during January, February, and March, 1897.

Nebraska weather and climate, G. D. SWEZEY and G. A. LOVELAND (*Nebraska Sta. Bul. 46, pts. 1–7, pp. 1–56, charts 14*).—This includes general notes on the weather and summaries of observations on pressure, temperature, precipitation, wind movement, and cloudiness at some 125 stations in the State, from January to July, 1896, inclusive.

Meteorological observations in Wyoming, 1891–'96, J. D. CONLEY (*Wyoming Sta. Rpt. 1896, Appen., pp. 1–44, figs. 9*).—A reprint of Bulletin 27 of the station (E. S. R., 8, pp. 32, 36).

On the possibility of weather predictions for longer periods of time, O. PETTERSSON (*Kgl. Landt. Akad. Handl., 35 (1896), No. 3, pp. 131–176*).

Chlorin in rain water (*Agl. Students' Gaz., 1897, Apr., p. 88*).—Observations at Cirencester show that for the 12 months ending September 30, 1896, the rainfall was 26.54 in. and that this amount of rain contained chlorids equal to 31.85 lbs. of salt per acre.

Studies of the upper atmosphere, H. DE GRAFFIGNY (*Rev. Scient., ser. 4, 7 (1897), No. 16, pp. 488–497, figs. 3*).

Atmospheric actinometry and the actinic constitution of the atmosphere, E. DUCLAUX (*Smithsonian Institution, Contributions to Knowledge, vol. 39, No. 1034, pp. 48; Washington, 1896*).

The atmosphere in relation to human life and health, F. A. R. RUSSELL (*Smithsonian Institution, Misc. Collections, vol. 39, No. 1072, pp. 148; Washington, 1896*).

The action of the sun and the moon on the atmosphere and the anomalies of pressure, P. GARRIGON-LAGRANGE (*Compt. Rend., 124 (1897), No. 17, pp. 914–916; Rev. Scient., ser. 4, 7 (1897), p. 595*).

WATER—SOILS.

Investigations on the temperature relations of different kinds of soil, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 4–5, pp. 305–401*).—This is an account of a continuation of experiments which the author has been carrying on for many years. The experiments here recorded related to the temperature relations of humus, clay, and quartz, and were carried out in pots in the usual manner. Notes on the experiments and tabulated data for temperature variations of the air and soil are given in detail. The experiments cover the period from

the year 1877 to date. The principal conclusions reached may be summarized as follows:

Of the three soil constituents, humus, clay, and quartz, the last heats and cools with the greatest rapidity, clay standing next in this respect, and humus lowest. As a consequence quartz shows the widest variations in temperature, clay and humus following in order. These differences between the various soil constituents are not apparent if the averages of soil temperatures for long periods are taken, since the temperature extremes are practically identical.

The influence of a particular soil constituent varies with the advance of the season. With a rising and with a high temperature the sand is the warmest, clay being second and humus last, other conditions being the same. With a falling and with lower temperatures the order is reversed. For this reason during the warmer half of the year, spring and summer, sand shows the highest temperature, humus the lowest, and clay stands intermediate; while during the colder half of the year, fall and winter, these constituents stand in reverse order in respect to temperature.

Under abnormal weather conditions, as, for instance, frequent and long-continued cold periods in summer or warm periods in winter, the reverse of the above is true.

The temperature of the soil is dependent upon the precipitation to the extent that in wet weather, especially if accompanied by cold, clay is, on the average, the coldest soil constituent.

In mixtures of clay, sand, and humus, the temperature in general depends upon the peculiarities of the individual constituents, the variations being greater in case of mixtures of clay and sand and humus and sand than in those of humus and clay.

Shallow artesian wells of South Dakota, J. H. SHEPARD (*South Dakota Sta. Bul. 49, pp. 24, map 1*).—This bulletin is a report on a continuation of investigations described in Bulletin 41 of the station (E. S. R., 7, p. 287), and gives mineral analyses of 3 samples of artesian water from the Grant County basin, 1 sample from the Hurley basin, 2 from the Turkey Ridge Creek basin, and 3 from the Sanborn County basin, as well as analyses of water from a surface well at Brookings and an isolated shallow artesian well at Ramsay. The composition of the principal waters reported is as follows:

Composition of shallow artesian waters from South Dakota.

Well.	Sulphuric acid, SO_3.	Chlorin.	Lime.	Magnesia.	Soda.	Carbon dioxid.
Twin Brooks	0.5152	0.0026	0.2494	0.1656	0.0913	0.1577
Amsden	.2956	.0022	.2064	.0906	.0214	.1128
Revillo	.6344	.0156	.3316	.2086	.0417	.1608
Hurley	.8401	.0071	.5790	.1729	.0149	.1890
Buchanan	.6370	.0051	.3871	.1600	.0621	.1923
Irene	.7356	.0049	.4332	.1664	.0757	.1693
Shepard	.3694	.0058	.1919	.1508	.0688	.1585
Artesian City	.7974	.0681	.3828	.0896	.2318	.0827
Beaver	1.0222	.1485	.4002	.1650	.3166	.0658
Redstone	1.0018	.1158	.3878	.1554	.2977	.0636
Woonsocket	1.0090	.0684	.3120	.1234	.4070	.0717

Geological, agricultural, and economic study of the Department of Dordogue, France, L. BEURET and R. BRUNET (*Ann. Inst. Nat. Agron., Admin., Enseign., et Recherches, 16 (1891-'92), No. 14, pp. 61-189, pls. 2, figs. 4, map 1*).

Alkali, B. C. BUFFUM (*Wyoming Sta. Rpt. 1896, Appen., pp. 219-253, pls. 6*).—A reprint of Bulletin 29 of the station (E. S. R., 8, p. 568).

Remarks on Hilgard's article on the distribution of salts in alkali soils, etc., C. OCHSENIUS (*Forsch. Geb. agr. Phys., 19 (1896), No. 4-5, pp. 413-415*).

Determination of the fertility of a soil by analysis, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 15, pp. 439-441*).

On Mayer's criticism of Hilgard's elutriation apparatus, E. W. HILGARD (*Forsch. Geb. agr. Phys., 19 (1896), No. 4-5, pp. 402-412*).

On marshes in Norway and their utilization, G. E. STANGELAND (*Christiania, Norway, 1896, pp. 120*).

The arid public lands: Their reclamation, management, and disposal, E. MEAD (*Arid America, 9 (1897), No. 2, pp. 1-9, figs. 3*).—A somewhat full discussion of this subject.

Analyses of drinking waters, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1895, pp. 41, 42*).—Analyses, with reference to sanitary condition, of 25 samples of water from springs, 8 from wells, 6 from driven wells, and 2 from brooks are reported. Of the samples of spring water, 25 per cent was impure; of the well water, 67 per cent.

Water, and its purification, S. RIDEAL (*London: Crosby Lockwood & Son, 1897, pp. XII, 292; rev. in Nature, 1897, Apr. 29, pp. 602, 603*).

FERTILIZERS.

Analyses and valuations of fertilizers, L. A. VOORHEES and J. P. STREET (*New Jersey Stas. Bul. 117, pp. 3-76*).—This bulletin gives the trade values of fertilizing constituents in 1896, and the results of examinations of the standard materials supplying them, as well as of home mixtures, factory-mixed fertilizers, and miscellaneous fertilizing substances. Analyses and valuations are given of 495 samples of fertilizing materials, including nitrate of soda, sulphate of ammonia, dried blood, dry ground fish, tankage, ground bone, dissolved boneblack, dissolved South Carolina rock phosphate, muriate of potash, sulphate of potash, kainit, ashes, nitrate of potash from tobacco extracts, tobacco stems, marl, stone lime, crematory garbage, wool waste, sea pumpkin, and mixed fertilizers.

"In 1896 over 64 per cent of the brands reach or exceed their guaranties in all particulars, as compared with not quite 59 per cent in 1895. The 138 deficiencies in 1896 occur in 118 brands, 16 being below in two, and 2 in all three of the forms of plant food. Of the 100 that are below in one and the 16 that are below in two particulars, 64 and 2, respectively, have this deficiency made up by exceeding their guaranty in other respects, showing a lack of skill or of carefulness in their preparation rather than an intent to defraud. . . .

"The average composition, estimated value, and selling price of all the brands of complete commercial fertilizers examined have been averaged each year for the past six years, and, together with the actual and the percentage difference by which the selling price exceeds the valuation, are shown in the following tabulation.

Average composition, valuation, and selling price of fertilizers in New Jersey.

Year.	Total nitrogen.	Total phosphoric acid.	Available phosphoric acid.	Insoluble phosphoric acid.	Potash.	Station's valuation.	Selling price.	Actual difference.	Percentage difference.
	Per ct.	Per cent.	Per cent.	Per cent.	Per ct.				
1891	2.71	10.12	7.29	2.83	4.21	$25.31	$34.23	$8.92	35.2
1892	2.74	10.38	7.70	2.67	4.50	25.66	34.19	8.53	33.2
1893	2.69	10.23	7.54	2.69	4.58	24.41	34.11	9.70	39.7
1894	2.87	10.40	7.37	3.03	4.94	24.83	34.17	9.34	37.6
1895	2.80	10.74	7.84	2.90	4.80	24.15	32.87	8.72	36.1
1896	2.51	10.86	8.21	2.65	5.02	21.70	30.33	8.63	39.8

"It will be observed that, notwithstanding a slight tendency toward furnishing larger amounts of phosphoric acid and potash, the composition of the average fertilizer has been remarkably uniform for the past six years, approximating to the following analysis:

Nitrogen	per cent..	2.5
Phosphoric acid, total	do....	11.0
Phosphoric acid, available	do....	8.0
Actual potash	do....	5.0
Price		$30

"An examination of the analyses [of home mixtures] shows that they were, on the whole, of the composition intended. . . . "The average estimated valuation is $28.34, while the average cost is $26.18."

Fertilizers, H. J. WHEELER, B. L. HARTWELL, and C. L. SARGENT (*Rhode Island Sta. Bul. 42, pp. 135–152*).—Analyses and valuations of 100 samples of fertilizing materials collected during 1896[1] are tabulated. The following tabular statement shows the comparative quality of fertilizers offered for sale in Rhode Island from 1891 to 1896:

Comparative quality of fertilizers in Rhode Island.

	1891.	1892.	1893.	1894.	1895.	1896.
Equal to or above the guaranty	71.1	80.7	75.7	80.9	89.0	90.7
Less than 0.3 per cent below the guaranty	10.6	9.0	13.8	8.0	5.0	4.8
More than 0.3 per cent below the guaranty	18.3	10.3	10.5	11.1	6.0	4.5

The value of the fertilizer control in raising the standard of quality of fertilizers offered for sale in the State and in disseminating correct information regarding the purchase and use of fertilizers is discussed. Analyses of a number of home mixtures are reported and their quality briefly discussed.

The effectiveness of artificial fertilizers (*Selskoye Khozyaistvo ī Lyesovodstvo, 181 (1896), Apr., pp. 950–952*).—Three series of experiments are reported. In the first, at the experiment station at Zapoli, in 1893, a decidedly increased yield both of barley and of the succeeding clover followed the use on light soil of about 200 lbs. of kainit per acre.

In the second series of experiments plats of rye in which clover was sown, and which had been fertilized in different cases with barnyard manure, superphosphate, bone meal, phosphorite, and dried blood in

[1] See also Bulletins 39 and 40 of the station (E. S. R., 8, pp. 682, 768).

the fall, were top-dressed in the spring with kainit and gypsum. The top-dressed plats showed a decided increase in yield during 3 years (1893-'95) over those not so treated, the gypsum apparently being more effective than the kainit. In the third series of experiments equal quantities of bone meal and Thomas slag were compared on barley. The results with Thomas slag compared very favorably with those produced by the bone meal.—P. FIREMAN.

Experiments with mineral fertilizers on the black soil of the Kursk government, Russia, in 1895, A. SHEKOUN (*Selskoye Khozyaistvo ī Lyesovodstvo, 182 (1896), June, pp. 409-417*).—Two series of experiments were made, one on a stiff soil, which is fertile but difficult to work; the other on a lighter soil, which is easier to cultivate but suffers more than the first in seasons of drought and excessive rainfall.

Mechanical and chemical analyses of these soils gave the following results:

	Light soil.	Heavy soil.
	Per cent.	*Per cent.*
Water in air-dried soil	3.130	4.040
The soil dried at 110° C. contained—		
Coarse organic matter (litter, roots, etc.)	.171	.128
Humus and water of constitution	6.111	8.863
Coarse sand	2.180	.960
Medium sand	8.765	9.530
Fine sand	16.745	18.145
Clayey sand	10.820	12.980
Finest particles separated by elutriation	55.208	49.394
Nitrogen	.324	.790
Phosphoric acid	.096	.026
Lime	.521	.548
Potash	.041	.825
Insoluble matter (in HCl)	85.005	85.090

Neither soil contained any carbon dioxid, but both were slightly acid and contained traces of ferrous compounds.

Nitrate of soda, phosphorite meal, sunflower ashes, and, in some instances, calcium carbonate were experimented with on 56 three-tenths-acre plats on each of the above soils, the crops grown being poppies, peas, lentils, oats, flax, spring wheat, sunflowers, and beets. Some of the plats in each case also received an application of 7 tons of straw or 18 tons of barnyard manure per acre. The results were inconclusive as regards nitrate of soda, but gave decisive indications as to the effects of phosphorite meal. Plats on which it was used gave increased yields in case of peas, flax, sunflowers, and wheat.

The world's consumption of fertilizers, MAIZIÈRES (*L'Engrais, 12 (1897), No. 15, pp. 348, 349*).—The amount and value of fertilizers annually consumed in the world are given as follows:

	Amount.	Value.
	Tons, 2,200 lbs.	*Dollars.*
Superphosphate	4,000,000	48,000,000
Nitrate of soda	1,100,000	41,800,000
Sulphate of ammonia	250,000	10,000,000
Potash salts	1,000,000	20,000,000

The consumption of commercial fertilizers in Vermont, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1895, pp. 43, 44*).—Statistics collected by the station indicate that "the present yearly fertilizer trade in Vermont approximates 13,000 tons."

Manures in Egypt and soil exhaustion, W. C. MACKENZIE and G. P. FOADEN (*University Public Instruction, Cairo, Egypt, 1896, pp. 70*).—The nature and causes of soil exhaustion and the maintenance of soil fertility by means of rotation, the growth of leguminous crops, and the use of manures are discussed, as well as the composition of Egyptian soils, the fertilizing effect of Nile water, the amount and quality of the manures available in Egypt, and the composition and fertilizing requirements of the following crops grown in that country: Cotton, clover, alfalfa, sugar cane, wheat, barley, maize, beans, and potatoes.

The economic value of farm manures, H. J. WATERS (*Missouri Sta. Bul. 34, pp. 20–25*).—This is a brief popular discussion of the conditions affecting the composition and value of farm manures, and some of the common losses of fertilizing materials in manures and practical means of preventing them.

How shall manure be used? M. MAERCKER, J. H. VOGEL, and P. WAGNER (*Mentzel und von Lengerke's landw. Kalender, 1897, II, pp. 63–126*).

Green manuring and the value of clovers and cowpeas in maintaining soil fertility, H. J. WATERS (*Missouri Sta. Bul. 34, pp. 26–33, figs. 2*).—A brief popular discussion is given of the value of red clover, crimson clover, and cowpeas for green manuring, with suggestions as to their culture and management.

Successful experiment in green manuring with lupines, A. LIDGATE (*Sugar, 9 (1897), No. 6, p. 81*).—Plowing under lupines proved beneficial to sugar cane crops.

Influence of humus upon the fertility of the soil, TANCRÉ (*Ztschr. landw. Ver. Rheinpreussen, 14 (1897), No. 12, pp. 105, 106*).

On the importance of lime in agriculture, and its application on different soils, K. ÅKERBERG (*Kgl. Landt. Akad. Handl., 35 (1896), No. 4, pp. 201–209*).

Marl and marling, R. HEINRICH (*Mergel und Mergeln. Berlin: P. Parey, 1896, pp. 63, figs. 14*).—This is a prize essay prepared under the auspices of the Mecklenburg Patriotic Union and is one of the many evidences of renewed interest in the subject of the agricultural uses of lime. The action of lime as a plant food and the dependence of the plant upon the lime content of the soil are briefly discussed. The more important chapters of the pamphlet are devoted to the chemical and physical action of lime in the soil and to the practical features of liming and marling. An interesting chapter is added on the injurious influences of lime on lupines. It has been noted for sometime that lupines, unlike other members of the Leguminosæ, are injured by the application of lime compounds to the soil. The author has carried out experiments to determine the effect of carbonate, phosphate, and sulphate of lime (gypsum), and magnesium carbonate on this plant. All of these substances proved injurious, the most marked effect being produced by calcium phosphate and magnesium carbonate, and the least injury resulting from gypsum. Magnesium carbonate at the rate of 0.5 per cent completely checked the growth of the plants, and calcium phosphate at the rate of 1 per cent produced the same result, and was very injurious at the rate of 0.5 per cent. It was found that this injurious action of carbonate of lime could be overcome to a considerable extent by the use of either kainit or nitrate of soda, or both.

On the injurious effect of Chile saltpeter, G. STAES (*Tidschr. Plantenziekt, 2 (1896), pp. 106–111*).—A brief review of the observations of de Caluwe[1] and Sjollema.[2]

The value of soot as a fertilizer, A. MAYER (*Jour. Landw., 25 (1897), No. 1, pp. 7–9*).—In one sample of soot made by a peat fire there was found 28.5 per cent of ash, 2.9 per cent of ammoniacal nitrogen, and 5 per cent of total nitrogen; in another 22.6 per cent of ash, 4.6 per cent of ammoniacal nitrogen, and 8 per cent of total nitrogen. The nitrogen not in ammoniacal form was found to be in form of

[1] Landbode, 1896, Nos. 19 and 23.

[2] Chem. Ztg., 2 (1896), No. 101, pp. 1002 (E. S. R., 8, p. 762).

pyridin bases, which are considered to be not only of little fertilizing value, but positively poisonous to plants. It is recommended, therefore, that the valuation of soot can be based on its ammoniacal nitrogen and not on its total nitrogen.

Analyses of commercial fertilizers, M. A. SCOVELL, A. M. PETER, and H. E. CURTIS (*Kentucky Sta. Bul. 65, pp. 99–108*).—Analyses and valuations of 52 samples of fertilizing materials are tabulated.

Inspection of fertilizers, C. D. WOODS, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Bul. 30, pp. 32*).—Notes on valuation and tabulated analyses of 142 samples of fertilizers.

Analyses of commercial fertilizers, W. L. HUTCHINSON (*State Chemist Mississippi Bul. 12, pp. 12*).—Analyses of 39 samples of fertilizers are reported, and a statement of guaranties of manufacturers during the season of 1896–'97 is given.

Report on the enforcement of the fertilizer control law, H. J. WATERS (*Missouri Sta. Bul. 34, pp. 1-9*).—A detailed statement of receipts and expenditures by the fertilizer control of the station, with notes on valuation and on the extent of the fertilizer trade in Missouri. According to what are considered conservative estimates, "the total consumption of commercial fertilizers in the State in 1896 was 2,000 tons," representing, at an average cost of $25 per ton, a total investment by the farmers of Missouri of $50,000. These fertilizers were used almost entirely "in the two tiers of counties on the eastern border of the State and in a few counties in southwest Missouri."

Fertilizer analyses, H. B. BATTLE (*North Carolina Sta. Special Buls. 40, pp. 3–12; 41, pp. 17–29; 42, pp. 33–50; 43, pp. 55–75; 44, pp. 79–103; 45, pp. 107–134*).—These bulletins include abstracts of the State fertilizer law, explanations of terms used in stating analyses, notes on valuation, freight rates, and tabulated analyses of 715 samples of fertilizing materials. Commencing with Bulletin 40 a new plan of stating analyses is inaugurated. "It consists in omitting the exact figures of the analysis of the fertilizer when they are up to or above the guaranty made by the manufacturer. If the percentages, as found by analysis, are lower than those guarantied by the manufacturer, then the exact figures are given."

Commercial fertilizers, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1895, pp. 17–34*).—An abstract of Bulletins 45, 46, and 47 of the station (E. S. R., 6, p. 980; 7, pp. 112, 196).

Analyses of fertilizers, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1895, pp. 37–40*).—Analyses and valuations of 54 samples of fertilizing materials, including mixed fertilizers, ashes, and muck are reported.

FIELD CROPS.

Miscellaneous fodder crops, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 191–202*).—A record is given of the growth, yield, and composition of the following crops grown on experimental plats: Japanese millet, Hungarian millet, cowpea, soja bean, flat pea, vetch and oats, Bokhara clover, crimson clover, alsike clover, white clover, wild vetch, and oats and peas. The yield of nutrients is calculated for each crop.

"The [cow] peas were planted in early June (to avoid the possibilities of early frosts), and harvested October 1, the tops being just barely touched by frost. Seed was well formed but not ripened on the Extra Early and Calico varieties. These two varieties also made the best growth and richest fodder. Judging from but a single year's experience, the cowpeas presented no advantage over soja beans except that of growing, in two cases, slightly richer fodder.

"The yield of dry matter was at best less than half, and the yield of protein less than two-thirds those given on the soja-bean plats. The latter crop grew with

as little attention, was harvested with greater ease, and is well relished by cattle. . . .

"The first year's growth [of flat pea (*Lathyrus sylvestris*)] with us was spindling, as is always the case. The second year's crop produced at the rate of 6¾ tons of green fodder, 1¾ tons of dry matter, and nearly ½ ton of crude protein per acre. The third year's (1896) crop was quite as large as was its predecessor. . . .

"It has not always commended itself to feeders, and further experience with it must be obtained before unqualified approval should be given. It analyzed higher in protein than any other of the experimental crops grown during 1895. . . .

"These crops have been grown on the station farm for several years experimentally, and have usually given good satisfaction. In the present cases yields have been obtained at the rate of from 7¼ to 10½ tons of green fodder, from 2 to 3 tons of dry matter, and from 500 to 850 lbs. of protein per acre. We have not, however, seen wherein vetch and oats are superior to peas and oats, of which greater tonnages can usually be grown in the same time, and at no greater expense. . . .

"Crimson clover, when sown in the spring, does well in Vermont. Several plats sown in the summer, which went under the snow in fine shape, were entirely missing in the spring, not a plant surviving."

Experiments with grain crops, C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 191–228*).—In each case the yields for 1895 are tabulated together with the averages for previous years. Twelve six-rowed, 20 two-rowed, and 9 hulless varieties of barley were tested on hundredth-acre plats. The leading varieties were Mandschuri, Oderbrucker, Two-rowed Italian, and Imperial Six-rowed.

Forty-seven varieties of peas were grown. Descriptions are given of the 6 leading varieties—Early Britain, White Wonder, Mummy, Prussian Blue, Chancellor, and Egyptian.

Fifty-two varieties of spring and 102 varieties of winter wheat are reported upon and descriptions given of the following leading varieties of spring wheat: Bart Tremenia, Herison Bearded, Pringle Champion, Wild Goose, and Red Fern. Notes are also given on different dates of sowing winter wheat, methods of seeding, quantity of seed per acre, effect of degree of ripeness at harvest on yield and quality and on value of grain for seed, and on selection of seed.

Ninety varieties of oats were tested. Descriptions are given of the following leading varieties: Joanette Black, Siberian, Waterloo, Bavarian, Egyptian, Poland White, and Vick American Banner.

A test of 13 varieties of beans is reported. Notes are also given on the influence of stirring the surface soil during the growing season, and of different dates of seeding.

Results obtained in 1896 from trial plats of grain, fodder corn, and roots, W. SAUNDERS (*Canada Exptl. Farms, Bul. 26, pp. 31*).—Particulars are given of the crops produced by varieties tested at five experimental farms. The average yield obtained at all the farms is given. A number of the varieties of oats, barley, wheat, and peas are new crossbred sorts originated at the experimental farms. As a rule, plantings were made on different dates at different places.

Oats.—Among 58 varieties, tested on tenth and twentieth acre plats, sown at the rate of 2 bu. per acre, Banner, Mennonite, Holstein

Prolific, White Schönen, Improved Ligowo, Columbus, Golden Beauty, American Triumph, American Beauty, Buckbee Illinois, White Russian, and Wallis, in the order named, produced the largest average crops on all the farms, averages ranging from 70 bu. 30 lbs. to 86 bu. 24 lbs. per acre. Banner alone appears among the 12 best sorts at each of the farms. Of the above varieties, 7 are first in productiveness at Ottawa; 5 are among the best 12 at Nappan, Nova Scotia, Indian Head, Northwest Territory, and Agassiz, British Columbia, and 8 are among the best 12 at Brandon, Manitoba, the various places at which the experimental farms are located. No new crossbred sorts are represented among these varieties.

Barley.—Seventeen 2-rowed and nineteen 6-rowed varieties were sown at the rate of 2 bu. per acre. French Chevalier, Danish Chevalier, Beaver, Newton, Canadian Thorpe, and Bolton, in the order named, produced the largest average yield on all the farms among the two-rowed varieties, the average yields ranging from 41 bu. 2 lbs. to 47 bu. 6 lbs. per acre. Bolton and Beaver are new crossbred sorts. Among the six-rowed varieties Mensury, Trooper, Champion, Common, Baxter, and Royal in the order given gave the largest average yields on all the farms, yields ranging from 44 bu. 4 lbs. to 58 bu. 22 lbs. per acre. Royal and Trooper are newly-originated varieties.

Spring wheat.—The rate of seeding was 1½ bu. per acre. Thirty-nine varieties were tested, 18 being varieties originated by the experimental farms. In the order named Preston, Monarch, Goose, Stanley, Red Fern, Wellman Fife, White Connell, Pringle Champlain, Old Red River, Huron, and Crown produced the largest crops. The average of results obtained at all the experimental farms varied from 31 bu. 2 lbs. to 35 bu. 37 lbs. per acre. Preston and Stanley are new sorts.

Peas.—Twenty-five varieties were on trial. The seed sown per acre varied from 1 to 3 bu., depending upon the size of the pea. Carlton, Agnes, Mackay, Kent, Prince, and Paragon, new crossbred sorts, ranked among the best 12.

Potatoes.—Eighty-three varieties were tested. Empire State gave the largest average yield (36 bu. 22 lbs. per acre) on all the experimental farms.

Results of tests of Indian corn, turnips, mangel-wurzels, and carrots are given in tabular form. The most profitable varieties were Pride of the North corn, Hartley Bronzed turnip, Mammoth Long Red mangel-wurzel, and White Belgian carrot.

Experiments with root crops, C. A. Zavitz (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 228–252*).—Reports of tests of potatoes, turnips, carrots, sugar beets, and mangel-wurzels. In each case the yields for 1895 are tabulated with the averages of previous years.

One hundred and eighty-four varieties of potatoes were grown. Descriptive notes are given on the following: Empire State, Thorburn, Summit, Tonhocks, Pearl of Savoy, American Wonder, and Great Divide. Experiments were made on depth of planting, preparation of

seed, selection of seed, size of one-eye sets, number of eyes in a set, plaster and lime on fresh-cut sets, planting eyes from different parts of the tuber, dates of planting, exposure of tubers previous to planting, application of fertilizers, and Rural trench system.

Sixty-eight varieties of Swede and 43 of fall turnips were tested. The leading varieties among the former were Hartley Bronze Top, White Swede, Kangaroo, and Buckbee Giant; among the latter Jersey Navet. Early American Purple Top, Greystone Improved, and Imperial Green Globe. Experiments were made in thinning plants in the drill and distances between drills. The largest yields were from 20-inch drills, plants 8 in. apart for Swedes and 4 in. for fall turnips.

Forty-five varieties of carrots were tested in 1895 on hundredth-acre plats. The leading varieties were Pearce Improved Half-long, Steel Brothers Short White, Guerande, and Mammoth Intermediate Smooth.

Thirteen varieties of sugar beets were grown.

Fifty five varieties of mangel-wurzels are reported upon. Evans Improved Mammoth Saw Log and Improved Mammoth Long Red are recommended.

Fertilizer tests with wheat, H. J. Waters (*Missouri Sta. Bul. 34, pp. 9–19*).—An account is given of experiments conducted on "a moderately rolling upland limestone clay loam of more than average fertility" during 3 years with nitrate of soda (150, 300, 450 lbs.), muriate of potash (150, 300, 450 lbs.), and dissolved boneblack (350, 700, 1,050 lbs.), singly, two by two, and all three together, and with bone meal (400 and 800 lbs.), lime (50 bu.), and barnyard manure (20 loads, or about 65,000 lbs.) used singly. The experiment was begun in 1893, and no fertilizer has been applied to the plat since that time.

The results, which are tabulated in full for 1894, 1895, and 1896, indicate that no benefit resulted from the use of lime. There was a total gain for the 3 years on the plats receiving barnyard manure of 28.5 bu. of grain and 1,927 lbs. of straw per acre. With the smaller application of the complete fertilizer there was a gain of 16.9 bu. of grain and 306 lbs. of straw. With the next larger application the gains were 23.1 bu. of grain and 1,435 lbs. of straw, and with the largest application 35.9 bu. of grain and 2,090 lbs. of straw. Where 400 lbs. of raw bone meal was substituted for dissolved boneblack in a mixture of 150 lbs. of nitrate of soda and 150 lbs. of muriate of potash the gains over unmanured plats were 34.3 bu. of grain and 2,267 lbs. of straw. When these amounts were doubled the gains were 39.8 bu. of grain and 3,376 lbs. of straw. Where bone meal was applied alone at the rate of 400 lbs. per acre the gains over unmanured plats during 3 years were 14.9 bu. and 750 lbs. of straw; with an application of 800 lbs. of bone meal the gains were 38.9 bu. of grain and 2,360 lbs. of straw. The use of the different ingredients singly or two by two was not profitable.

The causes of the exhaustion of soils and means of renovating them are briefly discussed.

Report of experiments conducted at the Provincial Experiment Garden at Ghent in 1894–'95, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1894–'95, pp. 100*).—A report of experiments with cereals, legumes, potatoes, and forage plants. The work consisted of seed, variety, and fertilizer tests. Results are given in tabular form.

Superphosphate, Thomas slag, and mineral phosphate were applied to wheat plats—in some cases before and in others after sowing. Superphosphate proved itself less effective than Thomas slag and mineral phosphate, and applying fertilizers before sowing was found to be the better practice. Either potash or nitrate of soda when applied to flax tended to lodge the crop and to retard maturity. The plats to which mineral phosphate was applied gave larger amounts of fiber than those on which Thomas slag and superphosphate were used.

Experiments with chicory showed that barnyard manure tended to malform the roots no more than commercial fertilizers. Plats fertilized with horse manure gave the greatest yields. Superphosphate gave a larger total yield than phosphate of potash, but the latter produced the larger amount of dry matter in the roots.

Commercial fertilizers were applied to potatoes broadcast, in the furrow, and in the hill. Crops were grown from whole tubers and from cuttings. Applying fertilizers in the hill and growing plants from whole tubers proved to be the better methods.

Rye grown from large seeds produced a greater percentage of large grains than rye from smaller seed.

It was found more profitable to sow hairy vetch (*Vicia villosa*) with barley than with rye.

Third annual report of field experiments carried out during 1896, D. A. GILCHRIST and F. H. FOULKES (*Jour. Univ. Extension College, Reading [England], Suppl. 4, pp. 64*).—These experiments on pasture, meadow, rotation, and various field crops were carried on in various parts of England, and are to be continued. No important conclusions have as yet been reached in the seeding and rotation experiments. Results are tabulated and notes on manures and their application are given.

Fertilizer experiments on pasture proved complete commercial fertilizers the most economical. Applications of phosphatic fertilizers and kainit improved the herbage. Superphosphate was found to be more suitable for chalky soils than basic slag. Nitrate of soda tended to make the herbage coarse.

The potato experiments showed that nitrate of soda increased the growth of the vines much more than that of the tubers. Potash manures proved very effective.

The carrot: Its culture as a field crop and its use (*Ztschr. landw. Ver. Hessen, 1897, No. 17, p. 133*).

Cotton culture in Oklahoma, G. E. MORROW (*Oklahoma Sta. Bul. 23, pp. 1–14*).—This is a popular bulletin on cotton culture in which climate, soils, and methods of cultivation are discussed. Notes by practical cotton growers are also given on cotton culture.

Flax culture, H. T. FRENCH (*Oregon Sta. Bul. 43, pp. 26, pls. 2*).—This bulletin is a popular presentation of the possibilities and advantages of flax culture for Washington. The information is compiled and includes notes upon the successful growth of flax in Oregon, discussion of climatic requirements necessary for growth of the crop with tables showing suitability of Washington conditions, a paper on flax culture by Mrs. W. P. Lord, history of the plant, and cultural directions, including seed, soil, and soil preparation, rotation, manuring of crop and soil exhaustion, manner and time of sowing, harvesting, and retting.

Grasses of Ontario, F. C. HARRISON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 126–186, pls. 28*).—Technical descriptions and illustrations are given of 26 species of grasses growing in the Dominion, and the composition of these grasses compiled from Dominion and United States analyses are included. Various seed mixtures of grasses for meadow and lawn purposes are given.

Silage and fodder crops, C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 252–269*).—Tabulated data are given for variety tests of 131 varieties of corn, 20 of millet, 13 of sorghum, 21 mixtures of grains, 7 of sunflowers, 7 of rape, 9 of pumpkins and squashes, 9 of clovers, and 21 of grasses.

Experiments as to distance of planting and selection of seed were also made with corn and rape.

Grass mixtures for clover soils (*Ztschr. landw. Ver. Hessen, 1897, No. 10, pp. 89*).

On the use of microörganisms in the culture of forage plants, E. LEPLAE (*Rev. gen. Agron., 6 (1897), No. 3, pp. 97–105, figs. 4*).—This article deals principally with the organisms found in the root tubercles of legumes.

New forage plants (*Sem. Agr., 17 (1897), No. 830, pp. 117, 118*).—Results of experiments with vetches, sachaline, and comfrey in France.

Mangel-wurzels, J. WRIGHTSON (*Agl. Gaz., 45 (1897), No. 1215, pp. 340, 341*).—Culture notes for growing mangel-wurzels in England.

Investigations on the production of potatoes grown from sprouted tubers, E. WOLLNY (*Forsch. Geb. agr. Phys., 19 (1896), No. 4–5, pp. 443–463, figs. 2*).—A report of the experiments with tabulated results.

Two varieties of potatoes A. DUBOIS (*Jour. Agr. Prat., 1 (1897), No. 15, p. 535*).—Paulseus Pluto and Paulseus Schwan, varieties of recent origin, are described.

Fertilizer tests with potatoes, E. ZACHAREWICZ (*Prog. Agr. et Vit., 27 (1897), No. 13, pp. 389–395*).

Annual report of the Neuhaus experiment station for potato culture, F. SCHIRMER (*Fühling's landw. Ztg., 46 (1897), No. 6, pp. 182–184*).

Sugar-beet culture in Norway, F. H. WERENSKIOLD (*Norsk. Landmandsblad, 15 (1896), No. 46, pp. 543, 544*).

Cultivation of the sugar beet, W. MAXWELL (*Sugar Jour. and Tropical Cultivator, 6 (1897), p. 16*).

Sugar beets, W. W. COOKE and W. P. HEADDEN (*Colorado Sta. Bul. 36, pp. 23*).—A popular bulletin on sugar-beet culture referring to work reported in former bulletins. A compiled table of analyses of sugar beets is given.

The size of the seed boll of the beet influences the yield, F. LUBANSKI (*Deut. landw. Presse, 24 (1897), No. 27, p. 247*).—In Russian experiments with the beet increased yields resulted from the use of seed from the larger seed bolls.

Experiments in sugar-beet growing in Scotland in 1896 (*Sugar, 9 (1897), No. 5, p. 65*).—The weight of the leaves and the impurities are greater in proportion when the roots are not fully ripe. The seed should be planted early, as the shorter periods of growth give poorest results. The largest amount of sugar obtained per acre was 2.2 tons. A table gives details.

The sugar beet, H. L. DE VILMORIN (*Jour. Agr. Prat., 1 (1897), No. 13, pp. 466–468, pl. 1*).—A description of eight varieties of sugar beets.

A review of Oregon sugar beets, G. W. SHAW (*Oregon Sta. Bul. 44, pp. 7–49*).—Statistics are given, and the history of the industry is reviewed. A description of the experimental work done in the State gives the conditions under which the beets

were grown, the particular results obtained, the yield, and the cost. A number of pages are devoted to cultivation and manufacture.

Production of sugar in Oregon from an economic standpoint, H. B. MILLER (*Oregon Sta. Bul. 44, pp. 2–6*).—A popular article, discussing the importance of the beet-sugar industry, and the requirements that have to be met to make it a success.

Beet sugar production (*Ohio Sta. Bul. 75, pp. 32, pls. 3, fig. 1*).—A reprint of Bulletin 55 of the Wisconsin Station, with additional notes on cost of production.

Coöperative sugar-beet tests (*Wyoming Sta. Press Bul. 5, pp. 4*).—Instructions how to obtain sugar-beet seed and how to cultivate the crop.

Sugar-beet experiments for 1897 (*Wyoming Sta. Circ. 4, pp. 4*).—Directions for making reports and sending samples for analysis.

Sugar-beet analyses and instructions to growers, A. E. SHUTTLEWORTH (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 34–40*).—Tabulated analyses of beets grown in various parts of Canada and an article on the growing of sugar beets

The nitrogenous constituents of the juice of the sugar beet, E. O. DE LIPPMAN (*Ber. deut. chem. Ges., 29, p. 2645; abs. in Bul. Soc. Chim. Paris, 17–18 (1897), No. 6, pp. 600, 601*).—Investigation has shown the presence in beet juice of asparagin, glutenin, betain, cholin, leucin, tyrosin, lecithin, legumin, glutanic acid, pyroglutanic acid, and cetrazic acid, and possibly nuclein. The author's studies of the molasses revealed the presence of xanthin, guanin, hypoxanthin, adenin, carnin, allantoin, vernin, and vicin.

Preparation and cultivation of our sugar lands, W. C. STUBBS (*Sugar, 9 (1897), No. 6, pp. 82–85*).—The article refers to work in Louisiana.

Sunflowers as a money crop (*Amer. Agr. (mid. ed.), 59 (1897), No. 15, p. 450*).

Tobacco: Tests of fertilizers, M. A. SCOVELL and R. J. SPURR (*Kentucky Sta. Bul. 66, pp. 3–6*).—A continuation of work reported in Bulletin 63 of the station (E. S. R., 8, p. 302). Results indicated that by applying potash fertilizer, and especially potash with nitrogen, a satisfactory yield of tobacco can be produced.

Climate and crops in Oklahoma: Field experiments with Kafir corn, 1896, G. E. MORROW (*Oklahoma Sta. Bul. 22, pp. 5–13*).—A popular bulletin giving the results of various field crops, comprising cereals, grasses, legumes, and cotton, so far as they have been grown in the Territory, together with recommendations as to their culture and use. An experiment with Kafir corn was not conclusive. The yields of seed ranged from less than 10 bu. to 68 bu. per acre. The total yields showed similar variations. The best yields were obtained from rows 30 in. apart with 3 in. between plants in the row. The smaller stalks were best for fodder.

Report of the agriculturist, J. F. HICKMAN (*Ohio Sta. Rpt. 1896, pp. 28–31*).—A summary of the work done at the station during the year. A table gives the area occupied by various farm crops, the total and average yields, and the market values.

HORTICULTURE.

Vegetable gardening (*Arkansas Sta. Bul. 44, pp. 48*).—This is a popular bulletin designed to furnish information relative to the culture of garden vegetables in Arkansas. The data were largely obtained from experiments conducted at Camden substation during the past three years.

In the introduction a general discussion is made of soils, preparation, manuring, rotation of crops, seed, seed sowing, the construction of hotbeds, cold frames, seedling boxes, plant beds, etc. The writer urges better methods of culture, thorough early preparation of the soil, intelligent use of fertilizers, and a regular rotation of crops. He advises ordinary vegetable growers to buy seed of reliable seedsmen rather than to grow it themselves.

The second part of the bulletin furnishes special directions for the culture of the following vegetables, and gives the varieties of each that succeeded best at the substation: Bush beans, pole beans, Lima beans, peas, asparagus, spinach, collards, cauliflower, spring cabbage, summer cabbage, fall and winter cabbage, cress, kale, lettuce, celery, tomatoes, eggplants, peppers, okra, cucumbers, cantaloupes, watermelons, squash, garden corn, salsify, onions, radishes, turnips, carrots, parsnips, and potatoes.

The utilization of unmerchantable apples, W. B. ALWOOD (*Virginia Sta. Bul. 57, pp. 147–160, figs. 6*).—This bulletin gives the results of experiments made at the station to find some profitable use for low-grade fruit. The author estimates that 40 per cent of the annual apple crop of Virginia is unmerchantable. Evaporating apples was considered in Bulletin 48 of the station (E. S. R., 8, p. 227); other methods are discussed here.

Cider making is discussed in considerable detail. With the "best of hand grinders and presses" it was found to be very unprofitable. Only 2 gal. of cider were obtained per bushel of apples. With apples at 8 cts. per bushel, cider made in this way cost 6 cts. per gallon. With a "medium-size custom grinder and press," run by an 8-horsepower engine, cider was produced at a cost of but 2.3 cts. per gallon, and 4 gal. were obtained per bushel of apples. The author believes that "at this price cider can be very profitably used for the manufacture of vinegar, jellies, drinking ciders, etc."

Lack of equipment necessitated somewhat incomplete work in jelly, marmalade, and vinegar making, yet enough was learned to indicate that the manufacture of at least some of them can be made profitable. From cider, at the price given above, a pure jelly was produced at a cost for material of about 1 ct. per pound of finished product, 11 gal. of cider (100 lbs.) making 25 lbs. of jelly. A jelly suitable for table use, made by adding 1 lb. of sugar to 5 lbs. of cider, cost for material about 3 cts. per pound of finished product, 40 lbs. of jelly being made per 100 lbs. of cider.

For marmalade a better class of apples is required than for cider. It was found advantageous, however, to cook the apples in cider rather than in water. With apples at 20 cts. per bushel, marmalade cost for material less than 2 cts. per pound of finished product, an average of 116 lbs. being made from 80 lbs. sliced fruit, 8 gal. of fresh cider, and 35 lbs. of sugar. The loss from paring and coring the apples averaged 25.4 per cent, while in the case of unpared fruit, the colander removed not over 5 per cent.

For pure cider vinegar, the author regards no mature apples too poor. Vinegar making in the ordinary way, by allowing cider to ferment at will, without controlling surrounding conditions, was far from profitable. By regulating the temperature and adding vinegar mother and cultures of acetic acid ferment, fairly good vinegar was secured, but

the process was slow and wasteful. By mixing equal parts of fermented cider and old vinegar, the process of fermentation was greatly hastened, but this method can not be followed without a large stock of old vinegar at hand. Factory methods of vinegar making were not tried.

Figures and descriptions are given of cider grinder and press, jelly evaporator, marmalade cooker, colander, etc.

The pineapple at Myers, O. CLUTE and W. A. MARSH (*Florida Sta. Bul. 37, pp. 390–404*).—The bulletin gives detailed directions for raising pineapples, and the experience of the station with them.

Directions for the construction of shelters for pineapples and the cost of material and construction are given in detail.

An experiment was begun at the station in 1894 to determine the relative profit of pineapple culture under shelter and in the open field. The shelter covered one-tenth of an acre. A number of varieties of pineapples were used. These were compared with one tenth of an acre of pineapples without shelter. The fertilizers used and the care given were the same in each case. The plants in the open field were injured by the freezes of 1894 and 1895. They threw out suckers at once, but produced no fruit in 1896. The sheltered plants were uninjured by the freezes, and produced 45 fruits in 1895 and 618 fruits in 1896. Besides the fruit 5,250 new plants were obtained from those under shelter. The fruit and plants obtained under shelter were worth at the ordinary price $516. The cost for labor and manures was but $20. The cost of raising one-tenth of an acre of pineapples without shelter was the same. The authors estimate that the cost of shelter is about $500 per acre. The average cost of land in condition for setting pineapples is about $60 per acre. The cost of plants is at present from $8 to $250 per thousand, according to the variety purchased.

Descriptions are given of 10 varieties of pineapples. The varieties recommended are, in order of value, Smooth Cayenne, Abbaka, Golden Queen, Enville City, Porto Rico, Black Jamaica, Prickly Cayenne, Red Spanish, and Sugar Loaf.

A single test made at the station in 1896 indicated that in regard to the keeping qualities, the varieties stand in the following order: Black Jamaica, Smooth Cayenne, Abbaka, Red Spanish, Golden Queen, Enville City.

The insects that have affected the pineapple at the station are the mealy bug and the chaff scale. Spraying with a strong solution of tobacco or with a sulphur solution is recommended. The plants are also affected by two diseases, blight and "long leaf." The first is characterized by the leaves turning yellow and the base of the plant rotting. Spraying with sulphur solution seemed to check the disease. Plants will often recover if taken up, trimmed, and reset. In the case of "long leaf," the leaves become contracted and make very slow growth, probably due to some unfavorable condition of the soil. Perfect drainage and shallow setting are recommended as preventives.

A table is given showing the maximum, minimum, and mean monthly

temperatures for 1894 and 1895. The bulletin also includes the opinions of a number of prominent growers on pineapple culture.

Causes of frogging and bloating of prunes, F. T. BIOLETTI (*California Sta. Bul. 114, pp. 9, figs. 2*).—The terms "frogging" and "bloating" are used somewhat indiscriminately by prune dryers; but in this bulletin the author seeks to limit them, and by "bloaters" those prunes are meant which in drying swell up to half again their natural size on account of a gas produced by fermentation around the pit. They become hollow and are frequently split in two. The "frogs," as distinguished from the "bloaters," are almost always small prunes, imperfectly developed, the failure to develop arising from various causes.

The claim that frogging and bloating were directly attributable to the practice of lye dipping led to an investigation of this and other processes through which the prunes are passed prior to their drying. In the lye process, the prunes before drying are passed through a nearly boiling solution of lye and then through water. Most of the prunes as they come from the lye are covered with cracks or checks. If acted upon too energetically some are quite denuded of their skin; while if not sufficiently acted upon, no breaks at all are produced. It is this last class which generally result in frogs. Properly checked prunes begin to dry immediately, the skin wrinkling in folds. The flesh remains of a light amber color, the outside a clear purplish-brown. Overtreated prunes dry up and quickly become hard. Prunes with unchecked skin do not show signs of immediate drying, but remain smooth and round for several days until they become a dirty brown and the flesh is discolored.

A drying establishment, where a pricking machine was used exclusively, was also visited. In this process the prunes, while passing over needles, were sprayed with warm water; no lye was used. The dried fruit in this process is black and shiny on the outside and of a very good appearance. Inside they are darker than in the lye-dipping process.

The author conducted some experiments in the laboratory, testing the strength of the lye solution and the effect of different durations of immersion, giving the results of his experiments at considerable length. The prunes used in his experiments were of three lots. The first were gathered from branches broken down with the weight of fruit, the second from unbroken branches of a heavily laden tree, and the third from trees bearing a moderate crop of fine, well-ripened fruit.

The first lot, although immersed in a 3 per cent boiling lye solution for a minute, did not check, and suffered from the cooking. The second lot, some of which were treated with a 6 per cent lye solution for twenty seconds, checked, but not all. The third lot, which were immersed in a 1.6 per cent solution for twenty to thirty seconds, gave the best results. All the prunes which had failed to check turned brown, and were a long time in drying, while the others dried in a few days. An attempt was made to determine the presence of a mold or other microörganism within the tissues of the brown prunes, but with-

out success. Cross sections of the skin of the different prunes were made in order to determine whether the relative thickness of the epidermis was in any way connected with the failure to check. A slight difference in the thickness of the epidermis was noticed, but not sufficient to account for the difference in behavior in dipping.

Samples of dried prunes, received later in the season, were classed and those graded as frogs averaged 120 to the pound and contained 35.27 per cent sugar. The large prunes were of good quality and averaged 43.2 per pound and contained 35.25 per cent sugar. The bloaters were large, dark colored inside in places, hollow, and in many cases the stone was split. They averaged 37.4 per pound and contained 39 per cent sugar. The higher content of sugar in the bloaters is accounted for by their complete ripeness when gathered. The bloaters are doubtless large, soft, very ripe prunes, which in falling from the tree become injured in such a way as to allow fermentation germs to find entrance, probably through the hole left by the detachment from the stem. The remedy would be frequent gathering and quick drying. The frogs are attributed to various causes, such as unsuitable or poor soils, overbearing, incomplete development, fungus attacks, in fact anything which prevents the fruit from attaining a normal and complete development and maturity will cause frogging. Judicious pruning of the trees is recommended, so as not to allow overbearing and to secure better lighting.

The relative merits of lye dipping and pricking are set forth at some length, and the conclusions drawn are that if fine, well-ripened prunes in good drying weather are to be had, the choice of methods must depend on the appearance which is most attractive to the average customer, and that the smaller sizes on the whole would be more advantageously treated by the pricking rather than the lye process.

The cultivated blackberries and dewberries, H. N. STARNES (*Georgia Sta. Bul. 33, pp. 493–523, pls. 4*).—This bulletin contains popular directions for the culture of blackberries and dewberries, results of experiments with these berries in 1896, including variety tests and a comparison of old with new plats, and descriptions of varieties tested.

The first part deals separately with soil and location, preparation, manuring, propagation, planting, cultivation, pruning, and diseases and remedies. The kind of cultivator and the form of dewberry trellis recommended are figured.

The variety tests included 29 varieties of blackberries and 5 varieties of dewberries. Relative yield and size of berry with dates of first bloom, first ripe fruit, and first picking are given in tables. The author draws the following conclusions:

"(1) The dewberries are, as a rule, earlier than blackberries. The one exception (Trinity Early) is doubtless a hybrid.

"(2) Dewberries, while earlier, are also less productive than the average blackberry. The one exception (Austin Improved) is also doubtless a hybrid.

"(3) Among blackberries the earlier varieties are generally the least productive, and possess a shorter bearing season. An exception is found in Early Harvest.

"(4) Midseason blackberries appear to be the heaviest yielders.

"(5) The largest blackberries are Early Cluster, Erie, Lawton, and Ohmer.

"(6) The largest dewberries are Manatee and Lucretia.

"(7) The earliest berries are Trinity Early, Austin Improved (dewberry), Early Harvest, Dallas, Early King, Maxwell, Thompson Early, and Lucretia (dewberry).

"(8) The latest berries of merit are Stone Hardy and Taylor.

"(9) The best succession for home use or local market would be Trinity Early, Early Harvest, Kittatinny, Early Cluster, Erie, Stone Hardy, and Taylor.

"(10) Restricted to a single berry, the choice would lie between Erie and Kittatinny."

For a comparison of the yield of old and new berry plats, 9 standard varieties of blackberries were used. One plat had stood six years and the other one two years. Otherwise the conditions were practically the same.

The details of the experiment are tabulated. The old plat was found to have deteriorated very noticeably, the average deterioration for the 9 varieties being 38.1 per cent; the greatest 58.9 per cent with Agawam, and the lowest 25.6 per cent with Ancient Briton. The author concludes that "a six-year-old plat (in this latitude) appears to have outlived its period of greatest usefulness and should be abandoned."

In the third part of the bulletin each of the 34 varieties of berries tested is illustrated, briefly described, and its relative merits pointed out.

The composition and classification of grapes, musts, and wines, E. W. HILGARD (*California Sta. Rpt. Viticult. Work, 1887–'93, pp. 3–16*).—The method and object of this work are restated from a former report (E. S. R., 5, p. 190), and criticisms upon them discussed. The value of chemical analyses of wines and musts is clearly pointed out. Notes on the classification of grapes, according to their wine-making qualities, are given. The characters of the following types of wines are given, the chief varieties producing them named, their composition according to European analyses given, and the differences observed in the same types and varieties in California briefly discussed: (1) Red Wine types, including Bordeaux or Claret, Rhenish, Burgundy, Jura, Southern French, North Italian, Austrian, and Hungarian; (2) White Wine types, including Rhenish White, Burgundy White, Sauterne, Southern French White, Austrian and Hungarian White.

The North Italian type is especially recommended. Of this the author says: "It would thus seem that the grapes of this very pronounced type, which combine in a remarkable degree the properties of high acidity and high saccharine strength, are likely to render important services to the wine industry of this State, especially in its southern portion, where the diminution of acid jeopardizes, or renders impossible, the production of sound and high-flavored wines with the varieties now in general culture."

Investigations of various types of grapes, their adaptability to different localities, and their value for wine making and other purposes, made during the seasons of 1887-'94, F. T. BIOLETTI (*California Sta. Rpt. Viticult. Work, 1887-'93, pp. 17-372*).—The analyses of musts and wines for this report were made by G. E. Colby. The various types of grapes are considered, and the varieties included under each type discussed and described. Records are given of the treatment of the various samples of grapes received, and for each variety a tabular statement is made of the chemical analyses of the musts and wines made from these samples. Summarized tabular statements of the analyses of all samples received from each locality are also given for each variety investigated. In all 114 varieties were studied, as follows: Bordeaux or Claret type, 10; Rhenish Red, 1; Burgundy Red, 3; Jura, 5; Southern French Red, 14; North Italian Red, 12; Austrian and Hungarian Red, 4; Rhenish White, 6; Burgundy White, 2; Sauterne, 4; Southern French White, 7; Austrian and Hungarian White, 11; Port, 7; Sherry, Madeira, and White Liqueur Wine, 13; Raisin Grapes, 3; Black Table Grapes, 6; Red Table Grapes, 2; White Table Grapes, 3; American Type, 1.

In addition to the above, notes are given on 31 varieties of recently imported grapes; also the analyses of a number of samples of wines sent to the station for examination are reported.

Preservation of fresh grapes, F. T. BIOLETTI (*California Sta. Rpt. Viticult. Work, 1887-'93, pp. 447-450*).—Under this head the results of experiments made at the station are given, with a general discussion of methods of preservation used there and elsewhere.

The experiments made at the station resulted as follows: In sawdust, grapes kept well for a month, but had begun to decay in six weeks and in two months were all unmarketable. Those not decayed, howev acquired a bad taste from the sawdust. This method proved infer to that of hanging the grapes in a dry room.

Grapes exposed to alcohol vapor in a box sealed with paraffin kept their appearance perfectly for five months. In nine months some of them had fallen from the stems and most of the white ones had turned brown. Some, however, looked perfectly fresh, but all tasted of alcohol and vinegar. Dipping the grapes into a weak solution of sulphurous acid before exposing them to alcohol vapor resulted about the same, except that fewer of the grapes turned brown.

Grapes first sterilized with sulphur fumes and then kept in an atmosphere of carbon dioxid were in a perfect state of preservation at the end of four months. In nine months their condition was the same, except that a few were molding. Placing a little alcohol and corrosive sublimate in the box, in addition to the carbon dioxid, resulted practically the same. Grapes confined in an atmosphere of sulphur fumes kept the same as those in carbon dioxid, except that the black ones bleached slightly and the white ones turned brown. In all these

cases the grapes tasted strongly of the paraffin with which the boxes were sealed.

Grapes hung in a box left open to the air as a check experiment began to mold and turn brown in 9 days and in 20 days all had moulded.

Analyses of the musts of the preserved grapes showed a decrease of sugar and an increase of acid in the grapes kept in alcohol vapor. Grapes preserved in carbon dioxid and in sulphur fumes maintained their usual sugar and acid contents.

The author sums up the results as follows: "These experiments, although in no case successful in preserving grapes in perfectly marketable condition, are very promising, and show that at least their appearance can be kept perfect. They show also the ease with which grapes, under the conditions in the experiments, took up odors, and the necessity of keeping them protected from anything that is liable to give them a bad flavor. It is for this reason that the use of carbonic-acid gas will, in all probability, be preferable to the use of either alcohol or sulphur fumes."

Resistant vines—their selection, adaptation, and grafting, A. P. HAYNE (*California Sta. Viticultural Rpt. 1896, Appen., pp. 53, figs. 13*).—This is a popular bulletin designed to give information in regard to replanting vineyards destroyed by phylloxera and to "correct misconceptions of some fundamental principles." The subject is treated under the following heads:

Phylloxera.—Notes are given on the native habitat of the phylloxera and the introduction of the insect into Europe from the United States. The evolution of resistant vines is discussed.

Remedies.—Under this head are discussed insecticides, submersion, planting in sand, quarantine, disinfection, and resistant vines. The latter are considered to be the only economical remedy against phylloxera in California. The author believes that the extra expense of grafting and care of resistant stocks would be fully repaid by the larger yield and better quality of grapes produced on resistant stocks, even if there were no phylloxera at all. Of 18 species of American grapes, all of which are more or less resistant, only 2, *Vitis rupestris* and *V. riparia*, were found to be of practical value, the others not adapting themselves readily to changed conditions. Hybrids between American species and *V. vinifera* thus far have not proved desirable, either as resistant stocks or as direct producers, except in special cases, as on alkaline soils, etc. The character of the land for resistant vines is discussed at some length.

Description of resistant vines.—Under this head the two most important resistant species, a number of their varieties, and a few hybrids are described and their relative merits discussed. On dry sandy soils *V. rupestris* is best; on rich, moist, compact soils *V. riparia*, and on excessively calcareous soils *V. berlandieri*. The varieties of these species vary greatly, some of them being of very little value.

Grafting.—Here are considered the effects of grafting, affinity, the structure of the grape cane in its relation to grafting, and the like. The different methods of grafting are described and illustrated. The time of grafting, choice of scions, and care of grafted vines are discussed.

Nurseries.—Under this head are considered the choice and preparation of the soil, planting, transplanting, and similar operations.

Lilium harrisii and the electric light (*Garden and Forest, 10* (*1897*), *No. 478, p. 157*).—A report is given of an experiment made at Cornell University on the effect of electricity on Easter lilies. A bed of lilies was kept under uniform conditions, except that one part was exposed to the direct light of a globeless arc lamp, another to the light of the same lamp after passing through a pane of glass which cut out some of the ultra-violet rays, and another was shaded from the light. The light burned from 5 p. m. to 6 a. m. for four months.

The plants of the lighted parts grew taller and more spindling, had narrower, lighter-colored leaves, and were more subject to disease than those in the shaded part. The plants in the direct light showed these effects most. The flower buds in the naked light showed dark-brown streaks on the side toward the light, the burns enlarging as the buds expanded. In the naked light the flowers appeared earliest and lasted 9 days. In the screened light they appeared 4 days later and lasted 9½ days. In the shaded part they appeared 9 days later and lasted 11 days. Plants taken from the shaded to the lighted part, after their stems were well developed, blossomed 7 days earlier than similar plants left in the shaded portion. They were perfectly healthy and lasted as long as those in the shade. The conclusion arrived at is that when buds of these lilies are an inch long it will probably pay to use the electric light to hasten their expansion, but the light should pass through glass to prevent injuring them.

Forced asparagus, G. WYTHES (*Gard. Chron., ser. 3, 21* (*1897*), *No. 535, pp. 201, 202*).—A method of forcing asparagus in permanent beds is given. The beds are long, narrow, raised above the level, and with narrow, deep trenches between them filled with tree leaves to furnish heat. The beds are covered with shutters or litter.

Burdock as a vegetable, I. NITOBE (*Garden and Forest, 10* (*1897*), *No. 477, pp. 143, 144*).—Remarks on the use of burdock as a vegetable by the Japanese. Its chemical composition is compared with that of some other vegetables. Notes on culture, varieties, and methods of cooking are included.

Popular varieties of celery (*Amer. Agr.* (*mid. ed.*), *59* (*1897*), *No. 18, p. 548, figs. 7*).—Illustrated notes on several varieties.

Hot water under pressure, J. D. EISELE (*Florists' Exchange, 9* (*1897*), *No. 15, pp. 380, 381*).—An address read before the Philadelphia Florists' Club. It discusses at some length the relative merits of elevated and depressed boiler systems for hot-water heating of greenhouses. The elevated boiler system is recommended. At Riverton, New Jersey, during the months of January, February, and March, 1896, the cost of fuel for heating a large greenhouse by steam was \$10 per 1,000 ft. of glass surface. The cost for heating a similar house by hot water was \$8 per 1,000 ft.—a saving of 20 per cent in favor of hot water.

Apples of Tennessee origin, R. L. WATTS (*Tennessee Sta. Bul., Vol. X, No. 1, pp. 18, figs. 14*).—A continuation of Bulletin, Vol. IX, No. 1, of the station (E. S. R., 8,

p. 496). Descriptions are given of 19 varieties of seedling apples of merit originated in Tennessee. Fourteen varieties are figured.

Cultivation and improvement of cacao, L. MARTINEZ (*Mexico, Secretaría de Fomento, 1894, pp. 108, pls. 11*).

Lemon culture, W. T. SWINGLE (*Florida Agr., 24 (1897), No. 19, pp. 290–292*).—A paper read before the Florida State Horticultural Society. An account is given of the method of lemon culture employed in Italy. Lemon growing in Florida is discussed. Directions are given for the treatment of lemon scab.

Notes on peach growing (*Amer. Gard., 18 (1897), No. 124, p. 340*).

A new classification of peaches (*Wiener illus. Gart. Ztg., 21 (1897), No. 4, pp. 130–132*).

The pineapple, G. I. RUSSELL (*Florida Farmer and Fruit Grower, 9 (1897), No. 19, pp. 296, 297*).—A paper read before the Florida State Horticultural Society.

Grafting fruit trees (*Gardening, 19 (1897), No. 945, p. 94, figs. 3*).—Top-grafting is described and illustrated.

Principles of pruning (*Wisconsin Farmer, 21 (1897), No. 17, p. 7*).

Elementary teachings on the subject of pruning trees, K. KOOPMANN (*Landw. Jahrb., 25 (1896), Nos. 4–5, pp. 497–618*).—The paper includes discussions of the various phases of the subject, citations from the literature of pruning, and the results of experiments conducted at the Königlichen Gärtner-Lehranstalt, 1886–'93.

Why orchard trees stop bearing, J. J. WILLIS (*Gard. Chron., ser. 3, 21 (1897), No. 536, p. 214*).

Raspberries (*Gardening, 19 (1897), No. 945, p. 90*).—Notes on culture and varieties.

Summer pruning the raspberry, E. S. GOFF (*Garden and Forest, 10 (1897), No. 480, p. 177*).—A report of an experiment made at the Wisconsin Station. Summer pruning increased the number of canes per crown in both red and black raspberries. This was more noticeable where both the main shoots and the laterals were pinched back than where only the main shoots were pinched. The author questions the wisdom of summer pruning, since the number of canes is usually too large to permit of the best development of fruit. No noticeable increase in yield of fruit was obtained by either method of summer pruning, but there was a decrease where both the main shoots and laterals were pruned.

Fruit drying, C. H. GORMAN (*Agl. Gaz. N. S. Wales, 8 (1897), No. 1, pp. 53–55*).—Notes are given on varieties of a number of fruits adapted to New South Wales. Methods of drying various fruits are also considered.

Fruit growing in British Columbia, M. J. HENRY (*Canadian Hort., 20 (1897), No. 4, p. 137, fig. 1*).—The following varieties are grown successfully: *Cherries*—Gen. Wood, Yellow Spanish, May Duke, Royal Ann, Black Tartarian; *apples*—Yellow Transparent, Maiden Blush, Wealthy, Duchess of Oldenburg, Talman Sweet, King, Baldwin, Ben Davis, Dutch Mignonne, Little Romanite; *gooseberries*—Downing, Oregon Champion. Most English gooseberries mildew badly. "Nearly every variety of plums and prunes grow to perfection."

Past experiences and future prospects of fruit growing in the Canadian Northwest, W. SAUNDERS (*Trans. Roy. Soc. Canada, ser. 2, 2 (1896–'97), sec. 4, pp. 131–136*).—Notes are given on about 20 native wild fruits. Efforts to introduce hardy cultivated orchard fruits, grapes, and strawberries have failed. With raspberries, currants, and gooseberries fair success is reported. Crossing native fruits with cultivated ones is being tried.

Variations of seedling fruits, T. F. RIVERS (*Gard. Chron., ser. 3, 21 (1897), No. 535, p. 209; Jour. Hort., 1897, No. 2530, pp. 245, 246*).—An address read before the London Horticultural Club.

The latent and active life of the grape, E. DURAND (*Vigne Amér., 21 (1897), No. 4, pp. 111–115*).

Campbell Early grape (*Amer. Gard., 18 (1897), No. 124, p. 342, fig. 1*).—This new variety is described and illustrated.

An improved method of budding grapes (*Prog. Agr. et Vit, 27 (1897), No. 14, pp. 408–410*).

Growing nuts for food (*Wisconsin Farmer, 21 (1897), No. 17, p. 7*).

Lilium speciosum, WEBSTER BROS. (*Canadian Hort., 20 (1897), No. 4, pp. 149, 150, fig. 1*).—Remarks on culture, propagation, and varieties.

Hardy water lilies, C. BLOMBERG (*Amer. Florist, 12 (1897), No. 463, pp. 908, 909; Florists' Exchange, 9 (1897), No. 16, p. 407; New England Florist, 3 (1897), No. 8, pp. 92, 93*).—A paper read before the Gardeners and Florists' Club of Boston. It deals with the culture of water lilies during both summer and winter.

The tiger flower (*Gardening, 19 (1897), No. 944, p. 78*).—Notes and illustration.

A group of garden irises (*Gardening, 19 (1897), No. 946, p. 108, fig. 1*).—Descriptions of a few species.

Narcissus horsfieldii, H. JOHNSON (*Canadian Hort., 20 (1897), No. 5, pp. 167, 168, fig. 1*).

The foxglove as a border plant (*Canadian Hort., 20 (1897), No. 3, pp. 94, 95, fig. 1*).

Some Arctic plants, H. CORREVON (*Rev. Hort., 69 (1897), No. 3, pp. 68–71; trans. in Garden, 51 (1897), No. 1326, pp. 285, 286*).—Notes are given on a number of Arctic plants and their culture.

The knotweeds (*Gardening, 19 (1897), No. 946, p. 105*).—Descriptions of a few species and notes on their value as ornamentals are given.

Some choice pompon dahlias, J. HESFORD (*Gardening, 19 (1897), No. 946, p. 101*).

Laburnum, W. J. BEAN (*Garden, 51 (1897), No. 1327, pp. 302, 303, pl. 1*).—Notes on several species and varieties.

Is the short-span-to-the-south house the best for rose growing? G. STOLLERY (*Amer. Florist, 12 (1897), No. 463, pp. 905, 906; Florists' Exchange, 9 (1897), No. 16, p. 406*).—A paper read before the Chicago Florists' Club. From three years' experience the author concludes that this style of house is inferior to the old-style three-quarter-span house. It was found more difficult to heat and the roses grown in it were more subject to mildew and produced poorer flowers than in the old-style house.

The Yellow Rambler rose (*Canadian Hort., 20 (1897), No. 5, pp. 170–172, figs. 2*).

Ayrshire roses (*Garden, 51 (1897), No. 1328, pp. 322, 323*).—Notes on culture and varieties.

The large-flowered cannas and their use, W. HAMPEL (*Möller's deut. Gärt. Ztg., 12 (1897), No. 12, pp. 137–139*).—Remarks are made on the use of cannas for ornamentation. Descriptions are given of about 50 varieties.

Cannas, A. ERNST (*Möller's deut. Gärt. Ztg., 12 (1897), No. 12, pp. 130, 131*).—Brief descriptions are given of about 40 varieties of cannas.

Cannas in North America, J. JENSEN (*Möller's deut. Gärt. Ztg., 12 (1897), No. 12, pp. 134, 135*).—An illustrated article giving directions for the culture of cannas in North America and a list of recommended varieties.

Flowers from seed, H. F. MICHELL (*Amer. Gard., 18 (1897), No. 124, pp. 333, 334, fig. 1*).—A paper read before the Pennsylvania Horticultural Society. Culture notes are given on a number of plants that will bloom out of doors the first year from seed.

Some good herbaceous perennials, R. B. WHYTE (*Canadian Hort., 20 (1897), Nos. 2, pp. 68–70; 3, pp. 106–108; 4, pp. 147, 148, fig. 1*).—Hardy herbaceous perennials are considered in a series of articles. Descriptions of about 30 species are given, with notes on their behavior and ornamental qualities.

Effective associations in the mixed border (*Gardening, 19 (1897), No. 945, p. 94*).

The field of landscape art (*Garden and Forest, 10 (1897), No. 479, p. 161*).

SEEDS—WEEDS.

The effect of cold on seeds, C. DE CANDOLLE (*Amer. Gard., 18 (1897), No. 124, p. 339*).—In a brief note taken from another publication it is stated that the author wrapped seeds of wheat, oats, fennel, lobelia, and the sensitive plant in tinned paper and inclosed them in a sheet-iron box, hermetically sealed, and subjected them in

a compressed air refrigerator to temperatures ranging from —37.78 C. to —53.89° C.—an average temperature of —41.93° C. The seeds were exposed for a total of 118 days. After each refrigeration the temperature slowly rose to that of the interior of the receiver, while the refrigerations took place rapidly. Upon the conclusion of the experiment the seeds were taken out and planted. The wheat, oats, and fennel came up promptly. Out of 60 seeds of the sensitive plant only 13 germinated. Of the lobelia seed, which, on account of their smallness, were not counted, only 10 sprouted. The check lots of the seed showed that the failure of the sensitive plant seed to germinate could not be attributed to the cold; but the lobelia seed were certainly killed by the low temperatures. The author thinks it is probable that seeds can remain uninjured in a medium unsuited for respiration, provided there is nothing to injure their protoplasm through chemical action.

Additional tests of garden seeds, L. F. KINNEY and G. E. ADAMS (*Rhode Island Sta. Bul. 43, pp. 13*).—This is in continuation of work published in Bulletin 35 of the station (E. S. R., 8, p. 233). One hundred and fifty-one samples of vegetable seeds were collected and tested. The vitality of 34 of the samples fell below 50 per cent. Twenty-three lots of the same variety of seeds were tested in 1895 and 1896, and in 10 lots the germination in 1896 was considerably lower than that of the previous year. The authors think from results of their investigations that it is evident that old seed were mixed with the samples obtained both years.

Duplicate tests were made of 60 samples in which the germinations are reported upon at length. These tests showed in 8 samples the same percentage of germination in both cases. In 10 samples the second test showed 1 per cent lower germination; in 4 samples, 2 per cent lower; in 5, 3 per cent lower; and in 3, 4 per cent lower, or a variation of less than 5 per cent in the 2 tests.

The hawkweed, L. R. JONES (*Vermont Sta. Rpt. 1895, pp. 115*).—Brief notes are given on the occurrence of the hawkweed (*Hieracium aurantiacum*), which threatens to become one of the most troublesome weed pests in the State. Experiments have been conducted to ascertain the best means of killing the weed in grass lands, and it was found that it may be completely exterminated in less than a year by plowing, followed by clean culture, so as to allow no growth of the plant above ground; and that salt applied to the plants kills them very quickly, the amount necessary not being sufficient to injure the grass materially. Where a large area of grass land is to be cleared of the weed, it is probable that the application of a cheap grade of salt at the rate of about 1 or 2 tons per acre would prove profitable; the land afterwards to be plowed and followed by clean cultivation.

The orange hawkweed, L. R. JONES and W. A. ORTON (*Vermont Sta. Bul. 56, pp. 15, figs. 5*).—This bulletin gives a more extended account of the orange hawkweed (*Hieracium aurantiacum*) than that included in the Annual Report of the station for 1895 (E. S. R., 8,

p. 987). The relationship, origin, and distribution of the weed are given and damage done and means of eradication are discussed. As indicated in the previous report, the application of salt has proved very beneficial in destroying it, and when used at the rate of 3,000 lbs. per acre every plant was killed. At the same time the application of salt to the grass land greatly improved the growth of the grass, which was a species of fescue.

Wild garlic, L. H. DEWEY (*U. S. Dept. Agr., Division of Botany Circ. 9, pp. 8, figs. 3*).—Popular notes are given on the origin and introduction of wild garlic (*Allium vineale*) into America. The plant is figured and described so that it may be readily distinguished from other species with which it might be confounded. The different forms of damage caused by wild garlic are mentioned and its geographic distribution in America shown by a map. Various methods of dissemination are described, such as the transportation of the bulblets with wheat and rye and the underground bulbs being carried with nursery stock, flower bulbs, and also through the sodding of lawns, etc. Methods of eradication are suggested, many of which are more or less efficient in reducing the abundance of the weeds, such as the rotation of crops, shaving the soil near the surface as often as the green shoots appear, and liberal applications of lime in pastures and meadows to improve the growth of grasses and clovers. Pasturing hogs is mentioned as a possible method of keeping it in check. The application of strong carbolic acid to the plants is also recommended.

Suggestions are given of methods for preventing milk and dairy products from being tainted by cattle eating the weed.

Report on practical work of the professor of biology, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 12–14, pl. 1*).—An investigation was undertaken to ascertain the amount of water transpired by 2 common weeds, wild mustard (*Brassica sinapistrum*) and pigweed (*Amarantus retroflexus*). A representative plant of each species was placed in pots in the garden, so that the conditions might be the same as in the field. Water was applied as required, and the pots weighed at regular intervals. The experiment was continued for 9 days, when it was terminated by unfavorable conditions. The meteorological conditions and amount of transpiration per day for each plant are tabulated, in which it is shown that the wild mustard transpired on an average 13.98 oz. of water, and the pigweed 10.51 oz. Based upon this average, the author states that, allowing 10 mustard plants to the square yard, 21 tons of water would be transpired daily from an acre of these weeds.

The author investigated the question as to what extent a Canadian thistle root will grow if cut into pieces. When cut into sections 1½ or 2 in. in length, it was seen that a vertical root will produce buds only as far as the fifth cutting.

Seed testing, T. Dietrich (*Jahresber. landw. Vers. Stat. Marburg, 1895–'96, pp. 7–9*).—A brief report is given of the work done during the year in testing various kinds of seed. Those most frequently received for testing were red clover, Swedish clover, alfalfa, and beet seed.

Reserve store of seeds, E. Convreur (*Ann. Soc. Linn. Lyon, 22 (1896), pp. 145–148; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 135*).—The reserve stores of starch and oil in *Ricinus communis* are said to increase proportionately in the seed whether attached to the plant or not. During germination the starch disappears rapidly, the oil more slowly.

Influence of electricity on germination, G. Tolomei (*Malpighia, 10 (1896), pp. 493–511, figs. 3; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 142*).—The author thinks that currents of great frequency have an injurious effect upon the vitality and consequently on the germination of seed and that the intensity of the injury varies with the species.

On the structure of the seed coats of some Euphorbias, B. Gram (*Bot. Tidsskr., 20 (1896), No. 3, pp. 358–389, pls. 5*).

Cutting and mounting sections of cereal grains and starchy tubers, J. D. Hyatt (*Jour. N. Y. Micros. Soc., 13 (1897), No. 2, pp. 19–24, pl. 1*).

On the presence and localization of hydrocyanic acid in seeds of certain Pomaceæ, L. Lutz (*Bul. Soc. Bot. France, 44 (1897), No. 1, pp. 26–32*).

The worst weeds of Wyoming, A. Nelson (*Wyoming Sta. Rpt. 1896, Appen., pp. 267–320, figs. 15*).—A reprint of Bulletin 31 of the station (E. S. R., 8, p. 794).

DISEASES OF PLANTS.

Sunstroke of the vine, F. T. Bioletti (*California Sta. Rpt. Viticult. Work, 1887–'93, pp. 450, 451, pl. 1*).—Notes are given on a diseased condition of grapevines which is characterized as follows:

"The leaves gradually, or sometimes rapidly, dried up and fell off, leaving the shoots exposed and allowing them to be killed by the sun. The vines first showed effects of the trouble in the early part of the summer, and some of those first attacked, though losing all their leaves, partly recovered and sent out new leaves. The leaves when first attacked often became spotted in a way somewhat resembling the Anaheim disease, but with the important difference that the line between the healthy tissue and the dead was clearly marked with little or no diseased tissue between."

Specimens of leaves and fruit were examined and no fungus parasites were found. It is thought to be the same as a disease known in France as *folletage*, which is physiological and not pathological in its character. It is caused by anything which disturbs the equilibrium between the water evaporated from the leaves and that taken up in the roots. A sudden period of dry hot weather or a sudden rise or fall of the water level may produce it. It is believed that there is no cure if the vine is badly affected. Consequently it is important to avoid the causes which produce the disease by careful management of irrigation and close attention to water level.

Investigations of plant diseases in the forcing house and garden, A. D. Selby (*Ohio Sta. Bul. 73, pp. 221–246, pls. 4, figs. 5*).—A preliminary report is given upon investigations of diseases of lettuce,

diseases caused by nematodes, leaf mildews, diseases of cucurbits, and tomato diseases.

Among the diseases of lettuce described are the lettuce rot, leaf blight, leaf perforation, and mildew. Of these diseases the rot, which is due to *Botrytis vulgaris*, is the most destructive. Preventive measures, which include sterilization of the houses, the use of fresh earth, and careful regulation of the temperature, are recommended, and the use of excessive amounts of water should be avoided. Too high a temperature, especially at night when ventilation is not easily secured, is conducive to the development of the fungus. After the rot makes its appearance all affected plants and leaves should be gathered and burned.

A leaf blight of lettuce was investigated to a limited extent. The affected plants were stunted in their growth and showed numerous small dead areas in the leaves. In general, the symptoms are those of plants suffering from root diseases, but no explanation was found for the trouble.

Specimens of diseased lettuce plants were received at the station, in which the leaves of the plants showed numerous perforations a millimeter or more in diameter, with irregular borders. Examination under the microscope showed the presence of a constant fungus, and specimens were sent to J. B Ellis, who describes the fungus as *Marsonia perforans*, n. sp., which is characterized as follows:

"Spots small, irregular in shape, 1 to 2 μ in diameter, pale, soon deciduous. Acervuli 100 to 120 μ in diameter, or by confluence larger. Conidia abundant, clavate or wedge-shaped, hyaline, faintly uniseptate, 11 to 15 by $2\frac{1}{2}$ to 3 μ exceptionally reaching 20 μ long."

The disease is regarded as a serious affection of greenhouse lettuce, but the extent of injury likely to result from the leaf perforation is not known.

The downy mildew of lettuce, caused by *Bremia lactucæ*, is briefly described and preventive measures suggested.

Nematode diseases on various ornamental and other plants are described, and the remedial treatment recommended is sterilization either by freezing or steaming all of the earth used in the greenhouse.

Brief notes are given on leaf mildews and spraying with fungicides under glass. The powdery mildew of composite plants has been successfully combatted by the use of potassium sulphid solution, 1 oz. to 3 gal. of water, or copper sulphate solution of the same strength. Three or four applications have proved sufficient to eradicate the disease.

The favorable influence of a weak Bordeaux mixture for the prevention of carnation leaf spot and leaf mold is mentioned. Applications of the same fungicide as well as Fowler's solution upon plants attacked with rust gave negative results.

Among the diseases of cucurbits the bacterial blight, due to *Bacillus*

tracheiphilus, powdery mildew, caused by *Plasmopara cubensis*, the cucumber spot (*Cladosporium cucumerium*), and anthracnose (*Colletotrichum lagenarium*) are described and preventive remedies suggested. Brief notes are also given on nematode attacks on forced cucumbers, and a phyllosticta of cucumbers.

A new leaf blight of muskmelons, which is probably due to *Alternaria brassicæ nigrescens*, is very briefly described. The fungus caused rather large dead spots on the leaves, followed by dying and curling under from tips and margins. The disease promises to be very injurious, and it is thought that Bordeaux mixture if properly applied would prevent its attacks. Notes are given of a severe attack of watermelon anthracnose (*Colletotrichum lagenarium*).

Among the tomato diseases mentioned the principal ones are a leaf mold, blight of forced tomatoes, leaf blight (probably referable to *Septoria lycopersici*), point rot, and bacterial tomato blight. The leaf mold, which is caused by *Cladosporium fulvum*, is one of the most common diseases of tomatoes under glass, and will probably be held in check by the use of Bordeaux mixture or ammoniacal copper carbonate.

The leaf blight of forced tomatoes described appeared in the station greenhouses in 1895 and reappeared in 1896. The younger leaves show the earliest indications of the disease, and have a drooping appearance, with the leaflets turned inward at the margin and with occasional dead areas. The attacked leaves soon die and hang from a more or less drooping leaf stem. The thriftiest and most vigorous plants were apparently as commonly attacked as the others, and later plantings suffered the most. The stems and leaf stalks of the affected plants showed black elongated spots upon them, and the green fruits were marked with brown, irregular spots. In general the leaf symptoms were similar to those caused by nematodes, but examinations failed to show any present. No successful remedial or preventive treatments have been found for this disease. If it should prove to be due to nematodes the usual precautions against these pests are recommended.

The tomato leaf blight, due to *Septoria lycopersici*, is reported as well as a leaf spot caused by *Alternaria solani*.

A rot of tomatoes at the point or blossom end was common in the greenhouse as well as in the garden. Observations seemed to show that this rot is associated with insufficient moisture in the soil.

A bacterial disease of tomatoes, which is probably the same as that described by E. F. Smith[1] as due to *Bacillus solanacearum*, is mentioned.

Brief notes are given on anthracnose, black rot, and a disease produced by a species of Fusarium on tomatoes. As yet no careful study has been made of them.

White spots on stored tobacco, H. GARMAN (*Kentucky Sta. Bul. 66, pp. 38, 39*).—The author mentions the occurrence of round whitish

[1] U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 12 (E. S. R., 8, p. 895).

spots varying from 0.06 to 0.25 of an inch in diameter, which marked a change in the texture of the leaf at this place. These spots are thought to interfere with the proper manipulation of the tobacco in the course of its preparation. Careful examinations in many cases failed to show any fungus present, but at other times some tufts of mycelium were observed, but being without spores the fungus could not be positively determined. The author quotes B. T. Galloway, of this Department, as saying that he had made a study of a similar affection of tobacco leaves and considers the spots to be due to drops of water or other matter resting upon the leaves.

Report of the botanist, L. R. JONES (*Vermont Sta. Rpt. 1895, pp. 66–115, pls. 4, figs. 8, dgms. 5*).—The results of investigations of the past year are reported upon under the following heads: Potato blight, Bordeaux mixture, disinfection of seed potatoes, orchard diseases and remedies, observations regarding oat smut and onion mildew in Vermont. The selection of seed as a preventive of late blight, the various forms of potato blight and their causes, field tests of Bordeaux mixture on potatoes, and frost injuries to apples and pears have all been reported upon to a considerable extent in Bulletin 49 of the station (E. S. R., 8, p. 138).

The relation of late blight to weather conditions is considered at some length by the author, and charts are given which show the meteorological conditions for July and August for four years and the relative amount of potato blight in those years.

A report is given of the potato diseases as they occurred in 1895, in which it is stated that 3 species of fungi were very commonly found upon the diseased leaves. These were *Macrosporium solani*, a species of Cladosporium, and a species of Alternaria. Studies of the Alternaria show that it is doubtful whether it can gain entrance into living potato leaves, but in all probability it aggravates or increases the diseased conditions when means are provided for the entrance of the spores into the tissue of the plant. The Cladosporium is clearly a saprophyte, and no extended studies were made of it. The author gives rather extended results of the studies of the Macrosporium, and also discusses the Alternaria, which has already been referred to. He has sought to ascertain with what forms of potato injury the Macrosporium is associated and whether it is possible to produce diseased spots by inoculating healthy potato leaves growing under normal conditions with spores taken from pure cultures of the fungus. It was clearly ascertained that much of the injury caused by this fungus is due to flea-beetle punctures or similar injuries, but many spots were found in which no relation could be traced to previous insect or other injury. In general it seems to be able to attack any plant weakened by whatever cause. In the investigations of the second point of inquiry it was shown that the spores are able to germinate and infect the healthy living tissues when sown upon it. The genetic relationship between Macrosporium and Alternaria is discussed at considerable length.

The various methods of preparing Bordeaux mixture were tested during the past season, the work being carried out by W. A. Orton. The value of the different mixtures was tested by means of settlings in a 4-inch column of the mixture after standing one hour. The importance of pure material and proper mixing is clearly shown. In all cases long-continued and thorough stirring improves the mixture. The best method to follow in practice is "to pour the two dilute solutions together carefully while stirring, or to pour the diluted sulphate into the diluted lime, stirring meanwhile. In this dilution it may be inconvenient to dilute the sulphate solution with one-half the total amount of water, in which case two-thirds of the water may be added to the lime and only one-third to the sulphate with good results, but the sulphate should not be more concentrated than this. If obliged to add the lime slowly, it is found that adding concentrated lime slowly to dilute sulphate gives better results than adding dilute lime slowly to the dilute sulphate."

The disinfection of seed tubers as a preventive of potato scab was investigated, corrosive sublimate solution being used. A general summary of the results shows that smooth seed taken from a crop having more or less scab and planted in clean soil gave a somewhat scabby crop, but when disinfected and planted in clean soil gave a perfectly clean crop. Very scabby seed washed and disinfected in the same way gave a crop slightly scabby, but much less so than similar untreated tubers. Smooth tubers disinfected and planted in infected soil produced a crop considerably freer from scab than where untreated seed tubers were used, but in no case was it entirely free. Treatment of tubers, when performed just prior to planting, in all cases retarded germination. In no case was there a gain or loss in the total yield which could be attributed to treatment of the seed sufficiently large to be of any significance.

In continuation of the experiments described in the Annual Report of the station for 1894, page 109 (E. S. R., 8, p. 60), experiments were conducted in spraying pears with Bordeaux mixture, with the same generally favorable results.

During the season investigations were conducted on the relative amount of smut in oats grown in Vermont and in other States. Samples of seed were secured from 9 western stations and sown in different series. The results are given at length and partially tabulated, showing that there were some conditions which seemed to be favorable to the development of smut at the station. This is particularly striking, since the previous reports have tended to show that conditions existing in Vermont usually tended to diminish the amount of smut. Seventy-five per cent of the samples sown at the Vermont station showed a higher percentage of smut than the same variety sown at the station from whence the samples were obtained. The general occurrence of oat smut throughout the State is reported upon, and while it appears

there is some variation from year to year there was more smut than usual in the oat crop throughout the State, and, as usually occurs, the highest percentage was found on plants grown from western rather than home-grown seed.

The occurrence of onion mildew in Vermont was reported late in 1895, and experiments are to be conducted to ascertain the method by which the fungus is carried over from year to year and in what way it infects the plants. Some of these experiments, at the time of the publication of the report, indicate that the spores are carried over in the soil and infect the growing crop in that way. It is thought probable that the collection and burning in autumn of all the leaves from diseased plants would prevent the infection of the soil, and that onions could be grown a second season with safety.

A new Micrococcus of potatoes and the parasites of potato starch grains, E. ROZE (*Compt. Rend., 123 (1896), No. 26, pp. 1323, 1324*).—The author reports having isolated from tubers of potatoes a new micrococcus to which the name *Micrococcus delacourianus* is given. The microörganism is from 1.5 to 2 μ in diameter, occurs in great abundance, and is considered the cause of a diseased condition called black gangrene (*gangrene noire*). The epidermis over the diseased areas is wrinkled and somewhat brown. The tissue underneath is rather solid but of a dark color. If placed under a bell jar and kept moist for a few days numerous mucilaginous spherical masses appear which are filled with the microörganism.

Notes are also given on two parasites of starch grains: *Amylotrogus discoideus* and *A. ramulosus*, mention of which has already been made (E. S. R., 8, p. 607).

In a subsequent note[1] the author mentions the discovery of three additional species of Amylotrogus to which the names *A. filiformis*, *A. lichenoides*, and *A. vittiformis* have been given. Of these *A. filiformis* penetrates the starch grain, as is the case with the first two species mentioned in the first reference, while the last two confine their attack to the surface.

Action of certain chemicals on the germination of spores of black rot, L. RAVAZ and G. GUIRAND (*Compt. Rend., 123 (1896), No. 24, pp. 1086–1088; also Rev. Scient., ser. 4, 7 (1897), No. 1, p. 22*).—The authors have investigated the effects of a large number of chemicals on the germination of the spores of the black-rot fungus. The substances were used in solutions of varying strength from 1: 1,000 to 1: 100,000. In general it was found that acidity of cultures favored germination while alkalinity, corresponding to 1: 10,000 of sulphuric acid, completely checked it. On this account, alkaline solutions have a much greater efficiency when applied to plants than acid ones. It was further found that copper solutions were less active against the black-rot fungus than against mildew, and that zinc had practically the same action as copper. Weak solutions of nickel favored the germination of the spores, and

[1] Compt. Rend., 124 (1897), No. 5, p. 248.

sulphur not only did not have any effect upon the germination of the spores, but when used in combination of copper, it frequently destroyed the efficiency of the copper salts.

Report on practical work of the professor of biology, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 8–12, pls. 2*).—A spray calendar is given for the insect and fungus enemies of the more important fruits and vegetables with formulas for the preparation and directions for the application of the insecticides and fungicides recommended.

A report is given of comparative tests of fungicides for the prevention of raspberry anthracnose and the leaf spot of currant and gooseberry, Bordeaux mixture, a solution of copper sulphate, and a solution of copper carbonate being used in four applications. The diseases in very few cases were observed on the foliage of the sprayed plants, while those unsprayed were attacked to a greater or less extent.

Botrytis douglasii as an enemy to pine tree culture, J. RITZEMA BOS (*Forstl. naturw. Ztschr., 6 (1897), No. 4, pp. 174–180, fig. 1*).

Bacteriosis of the hemp, V. PEGLION (*Malpighia, 10 (1896), pp. 556–560; abs. in Jour. Roy. Micros. Soc., 1897, II, p. 157*).—A bacterial disease of the stem of hemp is described. The organism closely resembles *Bacillus cubonianus* and may prove identical with it.

The bacteriosis of mulberry, V. PEGLION (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 1, pp. 10–13*).—Notes are given on the life history of *Bacterium mori.*

A parasitic agaric, N. C. COOKE (*Gard. Chron., ser. 3, 21 (1897), No. 540, p. 284*).—Notes are given of *Hypholoma fasciculare* found parasitic on the roots of raspberry canes in Australia.

On the polymorphism of Sporotrichum, E. BOULANGER (*Rev. Mycol., 19 (1897), No. 74, pp. 37–45, pls. 4*).

Concerning the causes of potato rots, FRANK (*Centbl. Bakt. und Par. Allg., 3 (1897), No. 1, pp. 13–17*).

Potato blights and fungicides, L. R. JONES (*Vermont Sta. Rpt., 1895, pp. 35, 36*).—An abstract of Bulletin 49 of the station (E. S. R., 8, pp. 138, 139).

Observations on the Rhizoctinia of the potato, E. ROZE (*Compt. Rend., 123 (1896), No. 23, pp. 1017–1019*).—The disease of potatoes caused by *Rhizoctinia solani* is sometimes associated with the potato scab caused by *Oöspora scabies*, but is seldom found on the early varieties, being almost entirely confined to the latter classes. It has been known since 1842, but is considered of little real importance, the fungus living upon the tuber and causing little loss. Late harvested potatoes are sometimes found whose surfaces are dotted with the numerous sclerotia of the fungus. Such tubers should not be planted, since the disease through them would be spread to the succeeding crop.

Forms of the black rot fungus, A. PRUNET (*Compt. Rend., 124 (1897), No. 5, pp. 250–252*).—The author has investigated the spring forms of the black rot fungus and finds it is carried through the winter by masses of sclerotia which, upon the return of the growing season, develop what he terms "invasion spores" through which the disease is spread. The perithecia and pycnidia are produced in no relative order or proportion.

Ripe rot of grapes, J. DUFOUR (*Chron. Agr. Cant. Vaud, 9 (1896), Nos. 22, pp. 603–609; 23, pp. 627–632; and 10 (1897), Nos. 2, pp. 27–33; 3, pp. 59–69*).—Notes are given on *Botrytis cinerea* with suggestions for its prevention.

On the treatment of stock in vineyards attacked by oïdium in 1896, J. DUFOUR (*Chron. Agr. Cant. Vaud, 10 (1897), No. 4, pp. 107–110*).—The author recommends the use of iron sulphate in various forms upon vines that had been attacked

the previous year by oïdium. It may be applied in the form of strong solutions, or mixtures of lime and iron sulphate. Early and thorough applications are urged. Formulas for making the different solutions are given together with detailed instructions for their application.

The smuts of cereals (*Rev. Mycol., 19 (1897), No. 74, pp. 45-48*).

A study of the Kansas Ustilagineæ, especially with reference to their germination, J. B. S. NORTON (*Trans. St. Louis Acad. Sci., 7 (1896), No. 10, pp. 229-241, pls. 5*).—Studies are given of 22 species of Ustilago, 3 of Entyloma, 4 of Tilletia, 1 of Doassansia, 2 of Sorosporum, and 1 of Urocystis.

Which rust is ravaging the Australian wheat crop? J. ERIKSSON (*Kgl. Landt. Akad. Handl., 35 (1896), No. 4, pp. 261-264*).—The author concludes that the crop is ravaged by black rust and brown rust but not by yellow rust.

The "blaasrost" (Peridermium strobi) on pine trees, J. ERIKSSON (*Kgl. Landt. Akad. Handl., 35 (1896), No. 4, pp. 240-258*).

On the biology of some fungi, L. MATRUCHOT (*Rev. gen. Bot., 9 (1897), No. 99, pp. 81-102, pl. 1, figs. 3*).

Fungus diseases, F. C. HARRISON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 187, 188, fig. 1*).—Brief notes are given on rose mildew and carnation rust, for the prevention of which the use of ammoniacal copper carbonate or potassium sulphid is recommended.

Notes on certain plant diseases in Tennessee, S. M. BAIN (*Tennessee Sta. Rpt. 1896, pp. 16-19*).—Popular notes are given on the occurrence, distribution, and suggested remedies for diseases of apple, peach, plum, cherry, pear, raspberry, blackberry, and strawberry.

Plant diseases observed in 1894 and 1895 (*Relat. Inst. Agron. Saõ Paulo, 7-8 (1896), pp. 319-326*).—Studies have been made of potato rot due to *Phytophthora infestans*, a borer (*Cemiostoma coffeellum*), a leaf disease of coffee due to *Alternaria* sp., and a mildew of coffee and a disease of coffee probably due to nematodes (*Diplogaster suspectus*). Sugar-cane borers were also investigated.

Spraying, A. H. BENSON (*Queensland Dept. Agr. Bul. 13, 2d ser., pp. 12*).—Popular notes are given on insect and fungus pests of fruits and plants, and formulas for the preparation of fungicides and insecticides, with directions for their practical application.

Spraying fruit for scab and rot (*Canadian Hort., 20 (1897), No. 5, p. 187, fig. 1*).

On the preparation of Bordeaux mixture, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 17, pp. 508, 509, fig. 1*).

On the preparation of copper solutions, L. DEGRULLY (*Prog. Agr. et. Vit., 27 (1897), No. 15, pp. 447-451*).—Formulas are given for the preparation of various copper fungicides.

The treatment of mildew and black rot in 1897, L. DEGRULLY (*Prog. Agr. et Vit., 27 (1897), No. 14, pp. 410-415*).—Directions and formulas are given for the use of fungicides against these diseases of grapes.

Report of the botanist, A. G. SELBY (*Ohio Sta. Rpt. 1896, pp. XXXVII-XL*).—A brief report is given of the investigations conducted during the year, most of which have been in the study of various fungus diseases of plants. Brief notes are also given relating to some of the more troublesome weeds of the State and suggestions given for legislation needed.

ENTOMOLOGY.

Experiments in beekeeping, O. J. LOWREY (*Vermont Sta. Rpt. 1895, pp. 146-148*).—A brief report is given of 7 experiments, a continuation of a series begun in 1894 and described in the Annual Report of the station for 1894 (E. S. R., 8, p. 63). No difference appeared to result from the use of different sized frames and divisible brood chambers for building up in the spring and for the production of honey,

either as regards amount or quality. Stimulative spring feeding in the latitude of Vermont was positively injurious, bringing about spring dwindling, etc. Bees will use bits and scraps of wax in comb construction during the honey flow. The Langdon nonswarmer proved a failure as far as preventing any desire to swarm. Bees will apparently swarm without drones in the hive, although a large number of drones in a hive may hasten swarming. A trial of 3 samples of comb foundation—made by different mills and presses—was made, with the result that samples of the honey made on them could not be distinguished in any way by the committee testing the matter at the Vermont Beekeepers' Association at its January meeting, 1896. The results of an experiment with 2 hives after a new model were not conclusive, although the model has been thus far satisfactory. According to this model hives are made with compartments in front of the brood chamber, each containing 2 wide frames holding 8 1-lb. boxes. They have a super covering the entire nest, holding 3 1-lb. boxes. They also contain 8 Langstroth frames and 1 division board. A partition between the brood nest and front chamber was made of half-inch lumber with strips of perforated metal to allow the bees to pass through.

Report of the apiculturist, R. F. HOLTERMANN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 285–292, figs. 4*).—The author describes in detail a number of experiments relating to wintering, feeding, comb foundation, and 5-banded Italian bees.

Relative to wintering, it is said it has been his custom to winter in a cellar, and that the loss sustained from this mode of wintering has averaged between 3 and 4 per cent. From his experiments he concludes that it will not pay to extract honey from hives with a view to making a profit, and then supply the bees with sirup for wintering.

Relative to comb foundation, it was found that bees prefer the heavier kinds, and that when supplied with a flat-bottom sort it is changed to natural foundation.

Notes on tobacco worms from observations made in 1896, H. GARMAN (*Kentucky Sta. Bul. 66, pp. 6–33, figs. 4*).—The author discusses experiments performed to determine the relative value of Paris-green solutions ranging from 1 lb. in 40 gal. to 1 lb. in 150 gal. of water, with reference to the age of tobacco worms. The experiments were divided into 3 series, and in each 3 small and 3 large worms were employed for each strength of solution used, or 18 worms (not including an equal number of "check" worms) in all, for every strength of the poison. The whole number of worms, including checks, used in the experiments was 252.

The experiments resulted in confirming a conclusion previously reached, namely, that small worms are killed more readily than large ones. In the case of the weak solutions the average length of life of the worms after treatment was 4.43 days for the small worms and 12.33 days for the large ones. The time required to kill the worms increased inversely as the strength of the solution. Making a practical

application of the results, he further states that weak solutions will serve for small worms. The results of the experiments are shown in detail in 3 tables.

The subject of worms found on drying tobacco is then briefly discussed, after which the author considers the subject of the two tobacco worms, *Phlegethontius carolina* and *P. celeus*, and their distribution. *P. celeus*, it is claimed, is a northern worm, although the moth, being a strong flyer, is often found far from its proper territory; which fact accounts for its being listed by systematists, along with the southern form, as distributed throughout the United States.

Relative to the variations found in the color of tobacco worms, he thinks differences in the quality of food an insufficient explanation, and advances the supposition that they are due largely to temperature. In support of this he instances the fact observed by himself that the flowers of the broom rape are pale in the hot July and August period of the year, and of a decided blue color during early spring and in September.

As to parasites he states that *Apanteles congregatus* is the most common Kentucky form. Other enemies of the worm noted are *Trichogramma pretiosa*, *Telenomus sphingis*, *Sturmia inquinata*, the fungi, *Empusa grylli* and *Sporotrichum globuliferum*, and the common skunk, *Mephitis mephitica*.

Referring to the literature upon the worms, the author points out that Harris's figure, which has been reproduced in many places as *P. celeus*, represents in reality the larva of *P. carolina;* while Harris's figure, explained as the larva of the southern worm, represents the young of the northern species.

Notes on several tobacco insects and on two imperfectly known diseases of tobacco, H. GARMAN (*Kentucky Sta. Bul. 66, pp. 33–38*).—The author notes the spined tobacco bug (*Euschistus variolarius*), the corn root worm, the corn worm (*Heliothis armigera*), and the tobacco bud worm (*H. rhexia*), as doing considerable damage, and *Scolopdrella immaculata* and *Japyx subterraneus* as being the probable cause of certain dwarfing noticed in tobacco plants. This is the first time these insects have been charged with injuries of this sort. Previously they have been supposed to feed on dead vegetable matter.

Report of the entomologist, F. M. WEBSTER (*Ohio Sta. Rpt. 1896, pp. 32–36*).—The author states that during the months of June and August from 1,200 to 1,500 packages of the Muscardine fungus were sent out by himself and assistant to farmers and that a personal inspection was made of the areas supplied. In the winter months the outbreaks of the San José scale were studied. During the year material was collected for an annotated list of the beneficial Hymenoptera of the State.

The insects reported as injurious during the year, besides the San José scale and the chinch bug, are the army worm (*Leucania unipuncta*), the cankerworm (*Anisopteryx vernata*), the grasshopper (*Melanoplus*

bivittatus), the harlequin cabbage bug (*Murgantia histrionica*), the bagworm (*Thyridopteryx ephemeræformis*), the asparagus beetle (*Crioceris asparagi*), the leaf miner (*Odontota dorsalis*), *Saperda candida*, *Disonycha triangularis*, white ants (*Termes flavipes*), *Valgus canaliculatus*, a minute capsid (*Halticus bractatus*), an undetermined species of Myzocallis, and the grape root worm (*Fidia viticida*).

The army worm was scarcely a general pest. The harlequin cabbage bug continues to increase along the southern border of the State. The asparagus beetle is spreading westward across the State. The ravages of the grape root worm along Lake Erie seem to be on the decline, though it is still a pest. The decline is attributed largely to the egg parasite (*Brachystichta fidiæ*), which has greatly increased within the past 2 years. The mite (*Heteropus ventricosus*) is noted as an ally of the egg parasite.

Instructions in spraying, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Bul. 105, 1897, pp. 15, figs. 14*).—In this popular bulletin the subject of spraying is very concisely treated. The solutions recommended are first described and then their application to the apple, plum, pear, peach, cherry, grape, raspberry, currant, gooseberry, tomato, potato, cabbage, and strawberry is tersely noted. Then follow brief descriptions and notes as to remedies against the following insects and injurious fungi: Tent caterpillars (*Clisiocampa americana* and *C. sylvatica*), the codling moth (*Carpocapsa pomonella*), cankerworms (*Anisopteryx vernata* and *A. pometaria*), oyster shell bark louse (*Mytilaspis pomorum*), the pear tree slug (*Eriocampa cerasi*), plum curculio (*Conotrachelus nenuphar*), the currant worm (*Nematus ribesii*), the grapevine beetle (*Haltica chalybea*), the round headed borer (*Saperda candida*), the flat headed borer (*Chrysobothris femorata*), the bud moth (*Tmetocera ocellana*), the grape leaf hopper (*Erythroneura vitis*), the red spider (*Tetranychus telarius*), and plant lice (Aphidæ), apple spot (*Fusicladium dendriticum*), leaf spot (*Entomosporium maculatum*), brown rot (*Monilia fructigena*), anthracnose (*Glœosporium venetum*), leaf blight or sun burn (*Sphærella fragariæ*), powdery mildew (*Sphærotheca mors-uvæ*) and the potato blight (*Phytophthora infestans*).

The solutions recommended are Bordeaux mixture, made of 4 lbs. copper sulphate, 4 lbs. lime, and 40 gal. of water; ammoniacal copper carbonate solution, made of 1 oz. of copper carbonate, 10 gal. water, and sufficient ammonia to dissolve the carbonate; Paris green mixture, composed of 1 lb. Paris green and from 200 to 300 gal. of water; pyrethrum mixture, made of 1 oz. of the fresh powder and 4 gal. of water; kerosene emulsion, made of ½ lb. hard soap or 1 qt. soft soap, 1 gal. boiling soft water, and 2 gal. kerosene. Appended are the following cautions: (1) To use the ammoniacal copper carbonate solution when there is danger of disfiguring the fruit with the Bordeaux mixture; (2) it is best to use an insectide and fungicide in combination and begin as soon as the buds begin to swell and again when the leaves appear, and then continue at intervals of 10 or 15 days until the trees have been sprayed

3 to 5 times (in rainy seasons more spraying would be required than in dry ones); (3) in no case spray when the trees are in bloom, but always immediately after.

Paris green is generally recommended as an insecticide. In the case of the red spider the remedy recommended is that of spraying with clear water and keeping the atmosphere about the plants moist.

Liquid Paris green, F. C. HARRISON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 186, 187*).—A report is given of a test of this material, which is said to be a waste product obtained in the manufacture of Paris green, and contains a considerable quantity of free acid. The mixture was sprayed upon tomato plants in strengths varying from 1 part of the insecticide to from 15 to 100 parts of water, and in every case the plants were more or less injured. The solutions were neutralized by the addition of lime, and when used in this form, 1 part of the liquid Paris green and lime to 50 parts or more of water, no injury was done the plants.

The use of the liquid Paris green in strengths of 1 part to 40, 50, 60, and 75 parts of water burned the foliage of apple trees badly.

The effect of the mixture upon the forest tent caterpillar was tested, and it was found that in strengths of 1 part to 100 parts of water it was very efficient in destroying this caterpillar.

Natural history of the bee, APIPHILE (*L'Apiculteur, 40 (1896), No. 12, pp. 428–442, figs. 9*).—The author continues here his popular treatise upon the bee. In this number he discusses the functions of the worker. These are the construction of comb, the rearing of young, the gathering of honey, pollen, propolis, and water, and the rearing of queens. Then he discusses the subject of fertile workers, and the habits of bees in general. The figures illustrate the forms of comb, eggs, larvæ in the comb, and covered honey cells.

Species and varieties of the honeybee and her position in the animal kingdom, A. GALE (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 814–817, pls. 2*).

Wintering, R. PINZOT (*L'Apiculteur, 40 (1896), No. 12, pp. 450–458*).—The author continues the discussion of the subject of wintering, and brings out the fact that for successful wintering there are necessary (1) strong colonies; (2) sufficient stores; and (3) a hygienic hive. These subjects he takes up more or less in detail and endeavors to show how one may distinguish a sufficiently strong colony, and whether or not there are sufficient provisions. For the ordinary frame hives he thinks there should be 15 kilos of provisions, although a colony might be wintered upon 12.

Relative to the hive he says it should be constructed of such material and be in such a form as to allow the escape of vapors and deleterious gases, while at the same time conserving the heat and protecting the bees from too rapid temperature changes. Ventilation, he thinks, should be at the bottom.

Wintering, A. MANJEAU (*L'Apiculteur, 41 (1897), No. 1, pp. 7–12*).—The author continues the discussion of this subject between Pinzot and Devauchelle. He summarizes the opinions of both and gives his own. Along with Devauchelle he is inclined to the opinion that the deleterious vapors of the hive should be gotten rid of at the top rather than at the bottom.

The management of section hives so as to prevent natural swarming, A. PINZOT (*L'Apiculteur, 41 (1897), No. 2, pp. 53–56*).

The Union hive, F. JULES (*L'Apiculteur, 41 (1897), No. 1, pp. 16–19*).—The author describes a hive in the construction of which he has endeavored to combine the vertical and horizontal systems. The hive is of sufficient size to allow of 25 frames, or of 24 frames and a partition. Dividing it into two parts by the partition, one is

able to build up vertically and by removing the partition one has the horizontal system. To provide against the effects of rapid atmospheric changes, the walls of the hives are constructed double so that there is a space of 18 millimeters of neutral air between the two walls.

How the swarm is suspended, BOURGEOIS (*L'Apiculteur, 41 (1897), No. 2, pp. 51, 52*).—The author endeavors to show that the phenomenon of a large swarm of bees being suspended from a limb or other object by a few bees is to be explained by the action of the atmosphere upon the small disks at the end of the bees' feet tend to produce small vacuums.

The adult age of workers, MARTIN (*L'Apiculteur, 41 (1897), No. 2, pp. 48–51*).—The author opposes the common belief that the workers attain their adult state five days after emerging, and states that he is able to show that they do not become fully mature until the lapse of seven days.

Increasing hives by artificial swarming and by increasing brood as a means of preventing natural swarming, R. PINZOT (*L'Apiculteur, 41 (1897), No. 1, pp. 56–59*).

The cattle tick, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 760–787, pls. 5, figs. 2*).—This discusses the cattle tick (*Ixodes bovis*), its geographical distribution, life history, and the diseases caused by it, as well as the measures to be employed against it, whether by removal of the ticks, by inoculation, or otherwise.

The Mexican cotton-boll weevil (Anthonomus grandis Boh.), L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circ. 6, 2d ser., pp. 5, figs. 3*).—This briefly describes *Anthonomus grandis*, its distribution, what little is known concerning its life history, and its effect upon the cotton plant. The common names of the moth are noted and the caution given not to confound it with what is known in the North as the "sharpshooter." A confusion of names has arisen from the fact that in the South any insect that punctures cotton bolls is given this name. A map shows the distribution of the weevil in northern Mexico and southern Texas. Hand picking the bolls while cotton picking is suggested as the best known method of getting rid of the pest.

Fluted scale (Icerya purchasi), P. H. ROLFS (*Florida Sta. Rpt. 1896, pp. 50–52*).—The life history and the ravages done by this insect are very briefly noted. *Pulvernaria innumerabilis* is noted as being often mistaken for it.

The San José or pernicious scale, A. D. HOPKINS (*West Virginia Farm Reporter, 5 (1897), No. 3–4, pp. 84–86*).—A paper read before the West Virginia State Horticultural Society, January 26, 1897, in which the subject is considered generally and the fear expressed that the insect may become generally injurious throughout the Mississippi basin and all areas within the austral life zone. The remedy of grubbing out infected stock and burning is recommended.

San José scale parasite, P. H. ROLFS (*Florida Sta. Rpt. 1896, pp. 49, 50*).—A fungus parasite was discovered during the year affecting this scale. Specimens of it were distributed to places where it was not found, with the result that healthy scales became diseased.

The occurrence of Fidonia piniaria, IV, KNAUTH (*Forstl. naturw. Ztschr., 6 (1897), No. 4, pp. 165–172*).—Observations on clearing ground of pupæ by means of swine, etc., and on the parasitism of the pupæ of this insect.

The Chilean cochineal, II, V. MAYET (*Prog. Agr. et Vit., 14 (1897), No. 11, pp. 319–325, pl. 1*).—The different forms of the insect (*Margarodes vitium*) from the egg to the adult are discussed.

An enemy of narcissus and amaryllis, J. G. JACK (*Garden and Forest, 10 (1897), No. 478, pp. 154–156, fig. 1*).—A description of (*Merodon equestris*) the narcissus fly, and its mode of attacking the plant is given. Historically it is traced back to a description by Réaumur. The figure illustrates the mode of damage to the bulb and the life history and certain destructive peculiarities of the fly.

The codling moth, M. V. SLINGERLAND (*Garden and Forest, 10 (1897), No. 468, pp. 58, 59*).—An abstract of an address at the meeting of the Western New York

Horticultural Society. Several of the common insecticides are more or less generally discussed.

Attacks of May bugs (Melolontha vulgaris) during the summer of 1896, V. BERGSOE (*Landmansblade, 29 (1896), pp. 572–574*).

Description of the structural characters of the larvæ of Sabine fusca, with notes on the four known larvæ of Sabine, H. G. DYAR (*Canadian Ent., 29 (1897), No. 4, pp. 77, 78*).

Two new species of beetles of the Tenebrionid genus Echocerus, F. H. CHITTENDEN (*Proc. U. S. Nat. Mus., 18 (1895), pp. 79, 80*).—The species are *Echocerus dentiger* and *E. recurvatus*.

Cockchafers and white grubs, G. BATTANCHON (*Prog. Agr. et Vit., 14 (1897), No. 11, pp. 326–328*).—Petroleum, tobacco, and carbon bisulphid are mentioned as remedies.

Insect enemies of the grapevine, L. BRUNER (*Nebraska State Hort. Soc. Rpt. 1895, pp. 68–162, fig. 1*).—This discusses 19 species of Orthoptera, 12 of Heteroptera, 35 of Homoptera, 36 of Coleoptera, 37 of Lepidoptera, 4 of Hymenoptera, and 5 of Diptera.

Revision of the North American Empidæ, a family of two-winged insects, D. W. COQUILLETT (*Proc. U. S. Nat. Mus., 18 (1895), pp. 387–440*).—The new genera Neoplasta, Empimorpha, Neocota, and Enhybus, and 66 new species are described.

Forest moths that have become orchard and garden pests, W. W. FROGGATT, (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 757–759, pls. 2*).—Discusses the painted acacia moth (*Teia anartoides*) and the gray-streaked moth (*Prodenia littoralis*).

Remarks on the synonymy of some North American Scolytid beetles, W. EICHHOFF (*Proc. U. S. Nat. Mus., 18 (1895), pp. 605–610*).—Discusses species of Hylastes, Phlœosinus, Hypothenemus, Pityophthorus, and Xyleborus.

Synonymical and descriptive notes on North American Orthoptera, S. H. SCUDDER (*Canadian Ent., 29 (1897), No. 4, pp. 73–76*).

The Coleoptera of Canada: XX. The Chrysomelidæ of Ontario and Quebec. Tribe IX—Galerucini (subtribe Halticini), H. F. WICKHAM (*Canadian Ent., 29 (1897), No. 2, pp. 29–37, figs. 5*).

The Coleoptera of Canada: XXII. The Cerambycidæ of Ontario and Quebec, H. F. WICKHAM (*Canadian Ent., 29 (1897), No. 4, pp. 81–88, figs. 3*).

Catalogue of the phytophagous and parasitic Hymenoptera of Vancouver Island, W. H. HARRINGTON (*Canadian Ent., 29 (1897), No. 2, pp. 43–47*).

On some reared parasitic hymenopterous insects from Ceylon, L. O. HOWARD and W. H. ASHMEAD (*Proc. U. S. Nat. Mus., 18 (1895), pp. 633–648*).—Four new genera and 23 new species are described.

The insects of the meadows, V. MAYET (*Prog. Agr. et Vit., 14 (1897) No. 1, pp. 25–27*).—This number considers the "nigger" (*Colaspidema atrum*), its history, life history, and means of dealing with it.

Report on economic entomology for the year 1896, G. H. CARPENTER (*Reprinted from the Report of the Council of the Royal Dublin Soc. for 1896, pp. 81–95, figs. 20*).—This gives a brief report on the occurrence and the means of riddance of some 22 common garden insects.

Injurious insects, BROCCHI (*Paris, 1896, pp. 15, pl. 1; see Naturæ novitates, 1897, No. 5, p. 162*).—A report on the observations made in 1895 at the entomological station of Paris.

Brief notes on the more injurious insects of the year, A. L. QUAINTANCE (*Florida Sta. Rpt. 1896, pp. 57–59*).—This is a briefly annotated list including *Margaronia hyalinate*, *M. nitidalis*, *Prodenia commelinæ*, *Laphygma longiperda*, *Heliothis armigera*, *Phlegethontius carolina*, *Eudamus proteus*, *Aleurodes ruborum*, *Cicadula exitiosa*, *Diedrocephala flaviceps*, *Raphigaster hilaris*, *Leptoglossus phyllopus*, *Aphis brassicæ*, *A. gossyppii*, and *Schistocerca americana*.

Report on practical work of the professor of biology, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 14–18, pl. 1*).—Brief notes are given on blister beetles, plum scales, oyster-shell bark louse, and the use of funnel shaped tree protectors for trapping codling moths.

Report of the entomologist, C. M. WEED (*New Hampshire Sta. Bul. 40, pp. 89–94, figs. 4*).—The author states that the season of 1896 was remarkable for a continuance of the attack of the American tent caterpillar and an invasion by the army worm, the former of which was noted in Bulletin 38 of the station (E. S. R., 8, p. 613) and the latter in Bulletin 39 (E. S. R., 8, p. 609). Besides this, the cankerworm, the codling moth, the apple maggot, the white grub, and the May beetle were somewhat injurious. The author passes briefly over the life history of the last and recommends that parent beetles be destroyed by a spray of London purple or Paris green. The cabbage root maggot (*Anthomyia brassicæ*) is also noted as doing some damage. Cutworms are also noted.

Report of the entomologist, G. H. PERKINS (*Vermont Sta. Rpt. 1895, pp. 116–145, figs. 33*).—An almost entirely compiled account of the apple magot (*Trypeta pomonella*), tent caterpillar, wireworm, grasshopper, army worm, bud moth, chinch bug, and cutworms.

Phylloxera, A. P. HAYNE (*California Sta. Rpt. Viticult. Work, 1887-'93, pp. 375–378*).—The author answers the question "What book on the Phylloxera shall I read, and where shall I get it?" often asked of the station by farmers, by saying that there is no complete work on the subject in English. The most complete part of the literature, he thinks, is that treating of resistant vines. He speaks briefly on the subject of the original home of the insect and its introduction into California, and then considers the subject of its California history, answering charges made against experimentation, and pointing out that the prediction (made when the subject was new) that the insect would spread and not become localized has been verified. The reason for the slow spread of the insect in California is attributed chiefly to the rarity of the winged form.

Destruction of the grapevine leaf beetle with pyrethrum, L. DEGRULLY (*Prog. Agr. et Vit., 14 (1897), Nos. 13, pp. 375–377; 14, pp. 407, 408*).—The author discusses several methods of destroying this beetle (*Graptodera ampelophaga*), such as mixing pyrethrum with copper spraying solutions at the rate of 1 to 1½ kg. of the former to 500 hectoliters of the latter, and mixtures of 1 part of pyrethrum and 4 parts by weight of sulphur. The most thorough method is to employ the first of these and then to gather the leaves to destroy the larvæ that can not be reached by the spray. A letter is quoted which states that good results were obtained by the use of a mixture of lime and pyrethrum in the proportions of 2.75 kg. of the former to 0.25 kg. of the latter. The editor also states that a decoction of equal parts of *Quassia amara* and *Delphinium staphysagria* has been successfully employed.

Destruction of the grapevine leaf beetle by means of a decoction of tobacco, L. DEGRULLY (*Prog. Agr. et Vit., 14 (1897), No. 16, p. 474*).—A letter is quoted which states that a solution of tobacco made of 1½ liters of the juice of tobacco and 100 liters of water has been used with success.

A new powder distributing apparatus, L. P. DE LA BATHE (*Prog. Agr. et Vit., 14 (1897), No. 8, pp. 220–222, figs. 2*).—The apparatus is a cylinder provided with a bellows at the top, a lever for working the same, a flexible tube from the bottom for directing the powder, and with straps for fastening to the back of the worker. A device in the bottom of the cylinder and a tube from the bellows regulate the "feeding" of the powder and prevent the distributing tube from becoming clogged.

FOODS—ANIMAL PRODUCTION.

Commercial feeds, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1895, pp. 44–56*).—Analyses (food and fertilizing ingredients) are given of the following commercial feeding stuffs: Animal meal, Atlas gluten meal, buckwheat flour, corn meal, corn and oats, corn oil cake, cotton-seed bran, cotton-seed meal, dairy feed, flour (Red Dog), graham

flour, Chicago gluten meal, Davenport gluten meal, Golden gluten meal, King gluten meal, Buffalo gluten feed, hominy food, India wheat hulls, India wheat meal, old and new process linseed meal, Chicago maize food, mixed feed, ground oats, oat middlings, rye, rye meal, rye and India meal, wheat bran, wheat food, wheat meal, wheat middlings, cream gluten feed, and horse food. In many cases the cost of the feeding stuffs is also given. Analyses of several of these feeds will be found in the following table:

Analyses of commercial feeds.

	Water.	Protein.	Ether extract.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Buckwheat flour	13.58	7.21	0.60	77.30	0.40	0.91
Corn oil cake	9.54	22.66	15.53	40.83	7.78	3.66
Cotton-seed bran	11.56	12.38	4.50	41.32	26.92	3.32
Graham flour	12.36	12.26	1.65	70.64	1.33	1.76
India wheat hulls	11.95	2.71	.06	34.00	49.13	2.15
Rye meal	12.50	11.60	2.20	69.82	2.14	1.74

The cost of the nutrients, fertilizer value of the different feeds, and their economical purchase are discussed. In the authors' opinion, the average goods offered for sale in Vermont during 1895 were up to the standard.

Tests of methods of preparing and feeding corn fodder, H. J. PATTERSON (*Maryland Sta. Bul. 41, pp. 125–140*).—Experiments were made with cattle to determine the feeding value and digestibility of shredded corn fodder prepared in different ways, and the digestibility of bran. The comparative value of cotton-seed hulls and other feeding stuffs is discussed.

Feeding experiments with cows.—A test was made with 2 lots of 4 and 5 cows, respectively, to determine the relative waste in feeding dry shredded corn fodder and grain separately, and wet shredded corn fodder and grain mixed. The test was divided into 2 periods of 32 and 25 days. In the first period lot 1 was fed a daily ration of 41 lbs. of corn fodder and 10 lbs. of a grain ration, consisting of equal parts of corn and corn-and-cob meal, wheat bran, and King gluten meal. The ration was fed dry and the corn fodder was fed separately. Lot 2 was fed the same ration wet and thoroughly mixed. In the second period the rations were reversed and the corn fodder was increased to 46 lbs. The uneaten residue was weighed in each case.

It was found that when the corn fodder and grain were fed separately and dry 13 per cent of the total amount of corn fodder was wasted. When they were thoroughly mixed and fed wet only 7.3 per cent was wasted.

A test was made with 11 cows to determine the effect on milk yield and gains in weight, of feeding corn fodder and grain in the same manner as in the previous experiment. Each ration was fed for 25 days. When the dry shredded corn fodder and grain were fed separately the

total milk yield was 3,709 lbs., when mixed and wet the total milk yield was 3,754.5 lbs., a small gain in favor of the latter method of feeding, which also resulted in somewhat larger gains in weight.

Digestion experiments with steers.—Experiments were made with 4 grade Shorthorn steers to determine the digestibility of shredded corn fodder and wheat bran fed in different ways. The methods followed were essentially the same as those used in previous tests reported in Bulletin 20 of the station (E. S. R., 5, p. 66). After a preliminary period of from 5 to 12 days duration, the digestion experiment proper lasted 6 days. The composition of the corn fodder and the wheat bran is given. The coëfficients of digestibility obtained in each case were as follows:

Coëfficients of digestibility of shredded corn fodder and wheat bran fed to steers.

	Dry matter.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Shredded corn fodder, fed dry:						
Steer 3	57.37	41.82	72.89	55.67	64.83	32.44
Steer 4	56.14	37.96	71.60	55.03	64.32	24.82
Average for 2 steers	56.75	39.89	72.24	55.35	64.57	28.63
Shredded corn fodder, fed wet:						
Steer 1	61.84	39.90	75.66	61.40	68.95	34.68
Steer 2	59.09	33.05	72.70	57.09	70.30	25.13
Average for 2 steers	60.46	36.48	74.18	59.22	69.64	29.90
Shredded corn fodder and wheat bran, fed separately and dry:						
Steer 3	61.45	70.25	66.96	64.30	57.13	28.96
Steer 4	56.02	69.76	69.91	59.72	44.97	22.56
Average for 2 steers	58.74	70.00	68.44	62.05	51.05	25.28
Dry shredded corn fodder and moistened wheat bran:						
Steer 1	55.15	68.46	65.91	58.34	48.53	12.44
Steer 2	65.05	71.48	73.96	67.55	61.90	32.56
Average for 2 steers	60.10	69.97	69.64	62.95	55.22	12.50
Shredded corn fodder and wheat bran, mixed and wet:						
Steer 1	62.43	73.08	67.41	66.81	51.76	33.08
Steer 2	63.44	75.29	71.78	67.92	54.06	25.53
Steer 3	61.25	70.05	53.24	64.96	57.59	28.54
Steer 4	65.62	76.60	80.26	66.84	59.25	42.01
Average for 4 steers	63.19	73.76	68.17	66.63	55.67	32.29

The bran used in this experiment was western bran. The composition and digestibility of old-process eastern wheat bran is quoted for comparison.

"The wetting of the fodder when fed alone, and also when fed with grain, made it more digestible. The method of feeding the ration as a 'mixed feed' gave a larger percentage of digestible matter than any of the methods tested. From these facts it is safe to say that the method of making a mixed feed of a ration is the best method to adopt in order to have the most complete consumption and the best returns for the food consumed.

"The results of the digestion experiment show western wheat bran to be far better than commonly supposed, and also that it is nearly as digestible as old process bran."

During 14 days 2 of the steers were fed the dry corn fodder and bran separately and two received the ration mixed and wet. The amount of water consumed and food wasted was recorded in each case. Less food was wasted when the second method of feeding was followed. Practically the same amounts of food and water were consumed in each case.

The composition and digestibility of cotton-seed hulls are given and

compared with that of other common feeding stuffs. The author states that "cotton-seed hulls have less food value than corn fodder and much less food value than clover hay. . . yet many farmers have bought cotton-seed hulls and allowed their cornstalks and fodder to go to waste."

Experiments in feeding calves, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 66, 67*).—*Value of skim milk and whole milk for calves.*—Three tests were made with calves to determine the feeding value of skim milk and whole milk. The first and second tests were each made with 2 grade calves and lasted 6 weeks and 25 days, respectively. The third test was made with 2 scrub calves and lasted about 6 weeks. One animal in each test was fed skim milk and the other whole milk. In addition the calves in the second test were fed some meal and clover hay and 1 calf in the third test was fed some meal and the other bran and oil cake. In the first test the calf fed skim milk gained 80 lbs. and consumed 8.9 lbs. per pound of gain, and the calf fed whole milk gained 126 lbs. and consumed 5.6 lbs. per pound of gain; in the second test the calf fed skim milk gained 117 lbs. and consumed 4.5 lbs. of milk with meal per pound of gain, and the calf fed whole milk gained 110 lbs. and consumed 4.2 lbs. of milk with meal per pound of gain; in the third test the calf fed skim milk gained 44 lbs. and consumed about 12 lbs. per pound of gain, and the calf fed whole milk gained 72 lbs. and consumed about 19 lbs. per pound of gain.

The scrub stock did not make as satisfactory gains as the other stock and, in the author's opinion, this illustrates the importance of breeding.

Value of sweet whey for calves.—The feeding value of sweet whey was tested with 2 calves. Sweet whey was gradually substituted for skim milk in the ration. Some bran and oil cake were fed with the whey. One of these calves was used in the third trial reported above, and the other was a native showing some breeding. During 75 days the first calf gained 85 lbs., "about the same gain that had previously been made on skim milk and meal." During 40 days the second calf gained 55 lbs.

In the author's opinion the results were not altogether satisfactory, and larger gains would be made with a better class of calves.

Steer-feeding experiments, V, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 60, pp. 107–146*).—A test which was practically a duplicate of work previously reported in Bulletin 34 of the station (E. S. R., 4, p. 475) was made with 20 steers to test the relative merits of a balanced ration, ground corn and ear corn, and to compare indoor and outdoor feeding. After a preliminary period of 2 weeks the test proper began October 23, 1895, and lasted 147 days. The steers were divided into 4 lots. Lots 1 and 2 consisted of 4 grade and 1 pure-bred Shorthorn and lots 3 and 4 of 3 grade and 1 pure-bred Shorthorn and 1 scrub. The weights of the respective lots were 5,615 lbs., 5,648 lbs., 5,793 lbs., and 5,983 lbs. at the beginning. Lot 1 was fed a ration of 15 parts of corn meal and 4 parts each of linseed

meal and bran, with cornstalks and alfalfa hay. Lot 2 was fed corn meal and cut corn stover. Lots 3 and 4 were fed ear corn and corn stover. Lots 1, 2, and 3 were fed in the barn and lot 4 out of doors. The steers were fed twice daily and given all they would eat. At the beginning of the test the steers were valued at $3.85 per hundred. The financial statement is based on ear corn at 26 cts., corn meal at 35 cts., linseed meal at 88 cts., bran at 50 cts., alfalfa at 20 cts., and corn stover at 15 cts. per 100 lbs.

The results are briefly summarized in the following table:

Results of steer-feeding experiment.

	Grain consumed.	Fodder consumed.	Grain consumed per pound of gain.	Fodder consumed per pound of gain.	Total food consumed per pound of gain.	Total gain in weight.	Cost per pound of gain.	Selling price per pound.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cents.*	*Cents.*
Lot 1 (corn meal, linseed meal, bran, cornstalks, and alfalfa hay)	15,277	4,863	7.52	2.39	9.91	2,030	3.94	4.10
Lot 2 (corn meal and corn stover)	13,231	3,036	9.11	2.09	11.20	1,451	3.50	4.00
Lot 3 (ear corn and corn stover)	16,114	2,676	14.02	2.32	16.34	1,149	3.99	3.90
Lot 4 (ear corn and corn stover)	16,860	2,285	15.52	2.10	17.62	1,086	4.35	3.80

The mean daily temperature of the barn and yard was recorded and the amounts of water consumed by each lot. The steers were fed at a loss in each case. In the authors' opinion this was due to the fact that they were sold at a time when prices were low.

For 8 weeks the manure from each lot was collected and the undigested residue of the food separated by washing. It constituted 3.69, 6.62, 15.59, and 15.95 per cent of the total manure of the respective lots.

The following conclusions were reached: The balanced ration of corn meal, linseed meal, and bran produced better gains than the other rations and less food was consumed per pound of gain, though a greater amount of food was consumed than by the lot fed corn meal. The steers fed the mixed grain ration were in better condition and were sold for a higher price than the others. Though the best gains were made on the mixed ration, it does not follow that they were made at the least cost. If the two lots had been sold for the same price the lot fed corn meal would have given the greater profit. The results do not warrant the indiscriminate use of linseed meal and bran when corn is cheap. Corn meal gave better returns than ear corn.

Although the winter was favorable for outdoor feeding, the steers fed out of doors gained less and ate more than the others.

Feeding corn smut to dairy cows, C. D. SMITH (*Michigan Sta. Bul. 137, pp. 41–46*).—Corn smut in varying amounts was fed to 3 grade Shorthorn cows and 1 grade Jersey cow in addition to a ration of corn, wheat bran, ground oats, and linseed meal. The cows were

in different stages of lactation. Two cows were fed as large quantities of the smut as they could be induced to eat, the amount being increased from 2 oz. at the start to 11 lbs. per day. The other two cows were fed moderate amounts, the smut being increased from 2 oz. at the start to 1 lb. per day. The composition of corn smut was found to be as follows:

Composition of corn smut.

	Per cent.
Water	8.30
Albuminoids	13.06
Carbohydrates	25.60
Cellulose	24.69
Sugar	4.00
Fat	1.35
Ash—considerable sand	22.50

The test lasted 49 days. The gains in weight for each cow are recorded, as well as the temperature which was taken on alternate days. At the beginning of the test the cows ate the smut very readily and the two receiving it in moderate quantities continued to prefer it to the grain ration up to the close of the test. On the other hand, the cows receiving large quantities did not eat it so readily, though it was never entirely rejected. The ash of the corn smut was found to be rich in phosphates of potash and magnesia like the ash of grain. In the analyst's opinion the high percentage of ash was due to sand which was accidentally present. The smut was examined for poisonous alkaloids, but none were found. The sugar in the smut may, in the author's opinion, account for the readiness with which the cattle ate it.

"The pregnant cows were watched for signs of abortion, but none appeared.

"Their milk yield was regular and constant, in the case of the cows giving milk, and no indication was given of any variation in this respect from normal conditions . . .

"The conclusion which can be safely drawn from this experiment is, that where cows are gradually brought into the habit of consuming large quantities of smut it does not seem hurtful to them. Whether the same thing would be true where cows unaccustomed to smut suddenly gain access to large quantities of it must remain for future experiment. It is safe to say, however, that any quantity of smut that would be at all likely to exist in a cornfield or on the stalks as fed under normal conditions to cows would not be dangerous to the health of the animals."

Fattening lambs—a comparison of fodders, H. W. MUMFORD (*Michigan Sta. Bul. 136, pp. 19–40*).—A feeding test was made with 100 grade Shropshire lambs to test the value of alfalfa, millet hay, oat straw, cornstalks, and bean straw as a whole or partial substitute for clover hay. The lambs were purchased in August at 2¾ cts. per pound. They were pastured for about 2 weeks, and then put on a field of rape for about 8 weeks. The average gain in weight while on the rape was 1 lb. per head per week. The lambs were then divided into 10 uniform lots of 10 each. The test proper began November 11, and continued for 14 weeks. All the lots were fed corn and roots. In addition lot 1 was fed clover hay, lot 2 alfalfa hay, lot 3 clover hay and millet hay,

lot 4 millet hay, lot 5 clover hay and oat straw, lot 6 oat straw, lot 7 clover hay and cornstalks, lot 8 cornstalks, lot 9 clover hay and bean straw, and lot 10 bean straw. The lambs were fed in a barn from troughs and racks. No attempt was made to compound rations of a definite nutritive ratio. Lot 1 was taken as the standard and the other lots were compared with this. The financial statement is based on the following prices per ton: Corn $10.71, ruta-bagas $2.50, clover hay $12, alfalfa $12, millet hay $10, oat straw $6, cornstalks $3, and bean straw $7.

The food consumed and gains made by each lamb for each week of the test are given in tabular form. The results are briefly summarized in the following table:

Results of feeding lambs.

	Average weight at beginning.	Average gain in weight.	Total dry matter consumed.	Dry matter consumed per pound of gain.	Cost per pound of gain.	Average profit on each lamb.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	
Lot 1 (corn, roots, and clover hay)	75.2	32.4	2,327.1	7.18	48.8	$1.58
Lot 2 (corn, roots, and alfalfa)	74.0	34.4	2,468.2	7.16	47.7	1.59
Lot 3 (corn, roots, clover hay, and millet hay)	74.8	33.2	2,362.6	7.12	45.6	1.68
Lot 4 (corn, roots, and millet hay)	72.9	[1]25.8	2,181.9	8.46	52.2	1.46
Lot 5 (corn, roots, clover hay, and oat straw)	73.4	31.7	2,340.4	7.38	45.2	1.66
Lot 6 (corn, roots, and oat straw)	73.9	28.5	2,374.3	8.33	45.3	1.67
Lot 7 (corn, roots, clover hay, and cornstalks	72.7	33.4	2,181.9	6.53	39.9	1.82
Lot 8 (corn, roots, and cornstalks)	75.3	30.2	2,041.4	6.76	35.8	1.98
Lot 9 (corn, roots, clover hay, and bean straw)	74.3	32.3	2,386.9	7.35	45.5	1.67
Lot 10 (corn, roots, and bean straw)	74.5	29.6	2,501.6	8.47	46.7	1.64

[1] This lot was troubled with scours.

The water consumed was recorded and found to be about 2 lbs. per head daily. The amount of each feeding stuff wasted was also recorded.

The following conclusions were drawn: Lambs can be profitably fattened without clover hay, and alfalfa, millet hay, oat straw, cornstalks, and bean straw may be substituted for it. A pound of gain was most economically produced in this experiment on a ration of corn, roots, and cornstalks. The least dry matter was required to produce a pound of gain on a ration including cornstalks, and the greatest amount on the millet hay ration. When clover hay was fed with the other feeding stuffs less dry matter was required per pound of gain. This advantage is not attributed to the clover hay, but to the fact that the ration was more varied.

Experiments in pig feeding, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 67, 68*).—This is a continuation of work previously reported (E. S. R., 7, p. 707).

Skim milk vs. sour milk for grown pigs.—Two tests were made, the first with 2 lots of 6 and 7 Yorkshire grade pigs, weighing 908 lbs. and 1,007 lbs., respectively, and the second with 2 lots of 9 and 8 Berkshire

grade pigs, weighing 904 lbs. and 569 lbs., respectively. The first test was divided into 2 periods of 3 weeks each. In the first period lot 1 was fed skim milk and lot 2 sour milk with some whey, peas, and middlings in each case. In the second period the rations were reversed. The total gain of both lots on sweet milk was 277 lbs., and on sour milk 269 lbs.

The second test was divided into 2 periods of 6 weeks each, and the rations fed and the conditions of feeding were the same as in the first test. The total gain of both lots on skim milk was 517 lbs., and on sour milk 991 lbs.

Wet vs. dry feed.—A test was made with 4 grade Yorkshire pigs, weighing 402 lbs. They were fed middlings in the form of slop for 6 weeks and gained 323 lbs. During the next 6 weeks they were fed dry meal and gained 132 lbs.

In the author's opinion there is a marked difference in favor of wet meal. "Individual characteristics of the pigs would account to some extent for the difference in results."

Feeding experiments, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 61, pp. 147–168*).—*Kafir-corn meal, corn meal, and soja-bean meal for pigs* (pp. 147–160).—A test was made with 4 lots of pigs, each consisting of 2 pure-bred Berkshires and 1 Poland China, to compare the feeding value of Kafir-corn meal and corn meal, with and without soja-bean meal. The test began November 7 and lasted 126 days. Lot 1 was fed red Kafir-corn meal, lot 2 corn meal, lot 3 red Kafir-corn meal and soja-bean meal 2:1, and lot 4 corn meal and soja-bean meal 2:1. Lots 1 and 3 made very small gains, and after a few weeks shorts was added to the ration in the proportion of 1:2. The pigs were kept in separate pens and fed 3 times daily. They were supplied with ashes, salt, and some fine soft coal. The feeds were soaked before feeding. The financial statement is based on soja-bean meal at $2, shorts at 80 cts., and Kafir-corn meal and corn meal at 35 cts. per 100 lbs. The food consumed and gains made by each pig during each week of the test are given in tabular form. The results are summarized in the following table:

Results of pig-feeding experiments.

	Grain consumed.	Total gain in weight.	Daily gain in weight.	Food consumed per pound of gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1 (Kafir-corn meal)	1,187.8	191	0.50	6.21
Lot 2 (corn meal)	2,166.4	547	1.44	3.96
Lot 3 (Kafir-corn meal and soja-bean meal)	1,476.7	306	2.42	4.82
Lot 4 (corn meal and soja-bean meal)	2,047.6	554	4.39	2.69

All the lots made the most rapid gains at the beginning of the test. Better gains were made on a mixture of corn meal and soja-bean meal than on Kafir-corn meal and soja-bean meal or Kafir-corn meal when

fed alone. The Kafir-corn meal was somewhat inferior to corn meal as a fattening food for pigs. When mixed with soja-bean meal very satisfactory gains were made.

Kafir-corn meal and corn meal as fattening feeds for Aberdeen-Angus heifers (pp. 161–168).—A test was made with 3 Aberdeen-Angus heifers to compare the feeding value of Kafir-corn meal and corn meal. No. 1 was fed red Kafir-corn meal and Nos. 2 and 3 corn meal. In each case cut corn fodder was fed in addition. After a time the ration was modified, as the gains made were not satisfactory, some linseed meal being fed with the Kafir-corn meal and corn meal, and alfalfa substituted for the corn fodder. The test began November 6, and lasted 112 days. Heifer No. 1 gained 154 lbs. and the average gain of heifers Nos. 2 and 3 was 190 lbs. In the authors' opinion the larger gain might be expected in the latter case since the heifers were older and larger.

"While the experiment with cattle here recorded can not have great weight, owing to the small number in the test, as well as the age and condition of the animals, it would, as far as it goes, in like manner indicate that red Kafir-corn meal is not quite equal to corn meal for fattening cattle, though the difference in favor of the corn is less marked than in the case of the hogs."

Pig feeding, C. D. SMITH (*Michigan Sta. Bul. 138, pp. 47–56*).—Tests were made to compare the relative gains of pigs before and after weaning, and to compare the gains made by pigs and calves when fed under similar conditions.

Gains made by pigs before and after weaning (pp. 47–53).—A test was made with 2 lots of pigs. The first consisted of 8 Duroc-Jerseys of one litter and the second of 9 Poland-Chinas, also of one litter. Lot 1 was weaned on May 18 when 59 days old and lot 2 on May 25 when 49 days old. Before weaning the sows and pigs were fed skim milk and a mixture of corn meal and middlings, 1:2; and after weaning the same ration was continued for the pigs. The weaning was done gradually. The financial statement is based on corn meal at 45 cts., middlings at 50 cts., and skim milk at 20 cts. per 100 lbs. The food consumed and the weekly gains of each pig are recorded. During the whole test lot 1 gained 836.5 lbs. and lot 2 748.25 lbs.

During the last 4 weeks before weaning the pigs consumed on an average 2.80 lbs. of dry matter per pound of gain, the cost of a pound of gain being 3.15 cts.; during the 4 weeks immediately after weaning the average was 2.35 lbs. of dry matter consumed per pound of gain, the cost being 2.55 cts. per pound; and during the last 4 weeks of the test the average was 3.29 lbs. of dry matter consumed per pound of gain, and the cost 2.69 cts. per pound.

"Both sows lost heavily in weight during the 4 weeks immediately preceding the weaning of the pigs. The Duroc-Jersey lost 11.5 lbs. and the Poland China 25 lbs. This extra shrinkage on the part of the latter sow very largely accounts for the increased cost of production of the gains in the 4 weeks preceding weaning. . . .

"Taking all these facts into consideration, the results of the test warrant the conclusion that it costs but little more to make growth on pigs before weaning than afterwards."

Similar tests made elsewhere are discussed and a summary is given of the results of 31 experiments made at the station and elsewhere with pigs of various weights fed a ration of skim milk with corn meal or corn meal and middlings. These indicate that "the older and heavier pigs grow, the greater the amount of feed it takes to maintain them and the less profit in keeping them."

Gains of pigs and calves compared (pp. 54–56).—A feeding test with 2 calves was made at the same time as the preceding test and under similar conditions. One was a pure-bred Holstein bull calf, and the other a Brown Swiss heifer calf, and both were 11 weeks old at the beginning of the test. The test began April 14 and lasted 17 weeks. For about a month the calves were fed separator skim milk. They were then given in addition clover hay and a grain ration consisting of linseed meal, oats, and bran, 1 : 2 : 2. From the latter part of June until the close of the test calf No. 1 was fed whole milk instead of skim milk. The amounts of food consumed and gains made by each calf are recorded in tabular form. The gains made by the calves and by the pigs in the previous test are compared in the following table:

Pigs and calves compared.

	Required for 1 pound of gain.			
	Milk.	Grain.	Hay.	Dry matter.
	Pounds.	*Pounds.*	*Pound.*	*Pounds.*
Pigs (average of 17)	8.57	2.26	....	2.82
Holstein calf (skim milk)	14.28	.15	0.13	1.61
Holstein calf (whole milk)	13.23	.49	.37	2.07
Brown Swiss calf (skim milk)	15.42	.61	.34	2.31

Though the pigs and calves were fed under similar conditions their gains were very different. The pigs required a much larger proportion of grain to skim milk than the calves.

Pig feeding, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 57–65*).—Experiments in continuation of previous work of the station (E. S. R., 8, p. 78) were made with pigs to test the value of corn meal *vs.* whole corn, skim milk *vs.* buttermilk, and wet corn meal *vs.* dry corn meal.

The first two questions were studied with 10 pigs about 6 weeks old at the beginning of the trial. Nos. 1 to 5 were Yorkshire-Chester Whites and Nos. 6 to 10 Berkshires. Nos. 1, 5, 6, 7, and 10 were fed a basal ration of 6 qt. of separator skim milk and 0.75 lb. of corn meal per head daily. After a short time corn meal and bran 1 : 1, in increasing amounts, was added to the basal ration until the pigs weighed about 200 lbs.; the bran was then omitted. Nos. 2, 8, and 9 received the same basal ration and in addition whole corn and bran, in increasing amounts, until the pigs weighed about 200 lbs., when the bran was omitted. Nos. 3 and 4 were fed the same ration as Nos. 1, 5, 6, 7, and 10, except that 7 qt. of buttermilk was fed in place of 6 qt. of skim milk. The test began June 22 and ended December 20. It was divided into 5 periods of from 18 to 62 days' duration. The financial statement

is based on bran at $16 and corn meal at $17.50 per ton and skim milk at 15 cts. and buttermilk at 13 cts. per 100 lbs. The amounts of food consumed and the gains made by each pig are recorded.

At the close of the test the pigs were sold at 5 cts. per pound, dressed weight. The average results from feeding the different rations are shown in the following table:

Summary of results of pig-feeding experiments.

	Weight at beginning.	Gain in live weight.	Dressed weight.	Dry matter consumed per pound of gain.	Profit per pig.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
Skim milk, corn meal, and bran (average of 5 pigs)	42	275	266	3.46	$1.02
Skim milk, whole corn, and bran (average of 3 pigs)	38	257	242	3.31	.83
Buttermilk, corn meal, and bran (average of 2 pigs)	37	321	305	3.33	2.10

In the author's opinion, if corn meal and corn are rated at the same price, the results were slightly in favor of the meal. If the cost of grinding and transportation is taken into account, feeding whole corn will frequently prove more economical. The pigs fed buttermilk grew faster and shrunk less in dressing than the pigs fed skim milk. Rating the buttermilk at 13 cts. and the skim milk at 15 cts. per 100 lbs., the financial returns were considerably in favor of buttermilk. Rating both at 15 cents per 100 lbs., the two gave about the same profit.

The relative value of skim milk and buttermilk is discussed at length.

Wet feeding *vs.* dry feeding was tested with 4 Chester White pigs about 12 weeks old at the beginning of the experiment. The test, which began June 22 and closed November 9, was divided into 5 periods, of from 18 to 41 days' duration. All the pigs were given 12 qt. of skim milk daily. At first 1.5 lbs. of corn meal was fed in addition, the amount being gradually increased. Two of the pigs received the corn meal wet and 2 dry. The financial statement is based on the same prices as above. At the close of the test the pigs were sold for 5 cts. per pound, dressed weight.

The average results for the two methods of feeding are shown in the following table:

Results of feeding corn meal wet and dry to pigs.

	Weight at beginning.	Gain in live weight.	Dressed weight.	Dry matter consumed per pound of gain.	Loss per pig.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
Corn meal, wet (average of 2 pigs)	86	243	281	3.88	$1.07
Corn meal, dry (average of 2 pigs)	83	208	235	4.35	2.27

Although both lots were fed at a loss, in the author's opinion feeding the meal wet was more economical.

The proper time to market pork is discussed and the fact pointed out that the pigs could not be profitably fattened beyond 200 lbs. The

Berkshire pigs were fed more economically than the others. The fertilizing value of the rations is briefly discussed.

The method of least squares as a means of determining the money values of commercial feeds, J. L. HILLS, J. W. BOYCE, and C. H. JONES (*Vermont Sta. Rpt. 1895, pp. 149–156*).—The estimation of the value of commercial feeds by the method of least squares was applied to Vermont feeding stuffs rated at the prices prevailing in 1895–'96.

Concerning wheat and its mill products, G. L. TELLER (*pp. 44*).—A reprint of Bulletin 42 of Arkansas Station (E. S. R., 8, p. 913).

Banana meal, J. P. HALL (*Jour. Jamaica Agr. Soc., 1 (1897), No. 4, pp. 153–155*).—Notes are given on the manufacture, uses, etc., of banana meal.

The chemistry of bread making (*Diet. and Hyg. Gaz., 13 (1897), No. 5, pp. 296–298*).—A brief summary of the subject.

How tomatoes are preserved in Italy (*Sci. Amer., 76 (1897), No. 15, p. 235; from Chambers's Journal*).—A cheap method of making tomato preserves, employed chiefly by the poorer classes.

Kephir: A fermented beverage made from cow's milk, C. D. SPIVAK (*Diet. and Hyg. Gaz., 13 (1897), No. 5, pp. 299–303*).—A descriptive article including the preparation, dietetic, and therapeutic effect of kephir, and an account of kephir ferment.

The principles of rational nutrition and vegetarian cookery, BONNEJOY (*Principes d'alimentation rationelle et de cuisine végétarienne. Paris: Berthier, [n. d.], pp. 269*).—The author describes and discusses milk, milk products, eggs, and many vegetable foods. A number of receipts for preparing foods are given.

Food in health and disease, I. B. YEO (*London, Paris, and Melbourne: Cassel & Co., Limited, 1896, pp. VIII, 592, figs. 4*).—A new and revised edition. The author discusses the different classes of nutrients and their functions, describes the ordinary articles of food and drink, and discusses at length the diet suited to persons of various ages and occupations, in health and disease. Many questions are taken up; for instance, the relative value of vegetables and animal food, and vegetarianism.

Cakes and ale, E. SPENCER (*London: Grant Richards, 1897, pp. XII, 282*).—The book includes a number of receipts for food and beverages.

Eating and drinking, A. H. HOY (*Chicago: A. C. McClurg & Co., 1896, pp. 304*).

The meat consumption of the German Empire, H. LICHTENFELT (*Landw. Jahrb., 26, (1897), No. 1, pp. 129–144, pls. 2*).

Preliminary report on the question of the introduction of large slaughter houses into Austria, E. SCHWEIDLAND (*Vorbericht über die Frage der Einfürung der Grossschlächtereien in Oesterreich, pp. 40. Niederösterreichischen Handels- und Gewerbekammer*).

The inspection of meat in Bulgaria, KVATCHKOFF and C. MOROT (*Jour. Hyg., 22 (1897), No. 1074, pp. 1090, 1091*).

Gluten feeds and meals, J. L. HILLS (*Vermont Sta. Rpt. 1895, p. 35*).—An abstract of Bulletin 48 of the station (E. S. R., 7, p. 972).

Concentrated feed stuffs, J. B. LINDSEY (*Agriculture of Massachusetts, 1896, pp. 307–327*).—The author defines a number of terms used in describing feeding stuffs, and discusses concentrated feeding stuffs and their preparation, composition, digestibility, and fertilizer value. The best ways of utilizing them are pointed out and also the need of a law regulating their manufacture and sale, so that the farmer may be assured that he is purchasing an article of definite known value.

Examination of concentrated feed stuffs, H. VON POST (*Nord. Mejeri Tidn., 11 (1896), No. 18, pp. 207–209*).

The theory of the physiological effect of light and gravity, J. LOEB (*Pfluger's Arch. Physiol., 66 (1897), No. 9–10, pp. 439–466*).

The use of molasses in feeding horses, L. GRANDEAU (*Jour. Agr. Prat., 61 (1897), No. 14, pp. 489–491*).—The author quotes the work of other investigators, and points out the value of molasses as part of a ration for horses.

Stock-feeding experiments at Lander, B. C. BUFFUM (*Wyoming Sta. Rpt. 1896, pp. 255–264*).—A reprint of Bulletin 30 of the station (E. S. R., 8, p. 815).

The poultry industry on a large and small scale, O. GRÜNHALDT (*Die industrielle Geflügelzucht in Gross- und Kleinbetreibe. Dresden: G. Schönfeldt, 1896, pp. —, figs. 31*).—Fourth edition of *Kunstlichen Geflügelzucht*, revised and enlarged.

The injury to fisheries due to waste from manufactories, J. KÖNIG and E. HASELHOFF (*Landw. Jahrb., 26 (1897), No. 1, pp. 75–127*).

VETERINARY SCIENCE AND PRACTICE.

The suppression and prevention of tuberculosis of cattle and its relation to human consumption, J. NELSON (*New Jersey Stas. Bul. 118, pp. 24*).—This is a brief compiled popular account, making note of the death rate from consumption (human and bovine) in several States and in several European countries, and describing tuberculosis, its causes, its degrees, its advanced symptoms, the tuberculin test, the Danish method of eradication by careful isolation, and what to do to keep the germs from developing in the human body. Milk is prominently noted as a source of infection.

Finally experiments and other evidence are adduced to illustrate the contagious nature of the disease. A brief bibliography of the subject is given.

Tapeworms of poultry, C. W. STILES and A. HASSALL (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 12, pp. 88, figs. 206*).—This bulletin is made up of a "Report upon the present knowledge of the tapeworms of poultry" by C. W. Stiles and a "Bibliography of the tapeworms of poultry" by A. Hassall. The first portion treats of the scientific and economic phases of the subject. An analytical key to the families and genera and the various species, diagnostically discussed, is given. Tables showing the relations of parasites of different domestic fowls and wild birds are also given. The methods of treatment and life history and sources of infection are noted, and the subject of prevention and remedial treatment fully discussed. Among the original experiments described those made to determine the value of turpentine as a remedy may be noted. Turpentine in different doses was given to chickens and found to be injurious when given in doses as great as ½ oz. (15 cc. or about 1 tablespoonful). Of 32 chickens given such a dose, 1 died. In another case where 25 cc. and in another where 30 cc. was used, the animals were very sick but recovered. It is concluded that it will be safe to dose with from 1 to 3 tablespoonfuls of turpentine according to the size of the chicken. Some 33 species of tapeworms are treated.

In the second portion of the bulletin, Mr. Hassall enumerates the titles of 150 papers that have appeared since 1727.

Wounds and their treatment, W. E. A. WYMAN (*South Carolina Sta. Bul. 27, pp. 8*).—The author discusses in a popular way the causes and appearances of wounds, the process of healing, and general treatment. Special lesions, chafing by the harness or saddle, bruises, lacerated wounds, and burns are treated separately.

Influenza, S. B. NELSON (*Washington Sta. Bul. 22, pp. 22*).—A popular article giving the synonyms, definition, history, causes, symptoms, forms, and treatment of this disease among horses.

The bovine tick fever, C. FULLER (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 760–787, pls. 5, figs. 2*).—This gives an account of the life history of the bovine tick *Ixodes bovis*, its introduction, and of the disease caused by it. Measures for preventing the disease, its extent in Queensland, and means of distribution are also given.

Tuberculosis in dairy cattle, T. P. C. KIRKPATRICK (*Lancet, London, 1897, No. 3845, pp. 1302*).—The author takes exception to the statement of a correspondent to the effect that out of 1,500 cows examined only 4 were found infected.

Koch's recent researches on tuberculin, G. S. WOODHEAD (*Nature, 55 (1897), No. 1433, pp. 567*).—A review.

On tuberculosis in cattle, P. SCHMIDT (*Tidskr. Landtmän, 17 (1896), pp. 185–190, 207–212, 221–224, 252–256, 275–279, 299–302*).

On the use of ichthyol in the treatment of pulmonary tuberculosis, M. LE TANNEUR (*Clermont: Daix frères, 1896, pp. 8; extract from Jour. Med. Paris, 1896, Aug. 9; noted in Bib. de la France, 86 (1897), No. 17, p. 27*).

The tuberculosis of cattle, E. LEHMANN (*Relat. Inst. Agron. São Paulo, Brazil, 7–8 (1894–'95), pp. 347–371*).—The author gives a somewhat lengthy discussion of the origin and etiology of tuberculosis, its occurrence and its diagnosis, its significance in hygiene and in social economy, its extinction, and the various means of preventing it.

The treatment of the hoofs, and on shoeing animals. II. The burro. III. The ox, E. LEHMANN, (*Relat. Inst. Agron. São Paulo, Brazil, 7–8 (1894–'95), pp. 336–346, figs. 7*).—Treats of the conformation of the burro's hoof, of the necessity for shoeing, shoeing, several varieties of shoes, the anatomy of the foot of the ox, and the shoeing of the same.

Wormy fowls, N. A. COBB (*Agl. Gaz. N. S. Wales, 7 (1896), No. 11, pp. 746–753, figs. 9*).—The nematode genus Heterakis and the diseases caused by the two species *H. inflexa* and *H. papillosa* are discussed, along with the remedies to be used against them.

The prognosis of pneumothorax, with some statistics as to mortality and duration, and an account of a series of cases of recovery, S. WEST (*Lancet, London, 1897, No. 3845, pp. 1264–1267*).

DAIRY FARMING—DAIRYING.

The production of milk richer in fat, SOXHLET (*Separate from Wochenbl. landw. Ver. Bayern, 1896, No. 40*).—This is a short account of investigations made by the author at the central experiment station in Munich. Reference is made to the experiments of Wolff, Fleischer, G. Kühn, and Stohmann on the subject. The author says nothing of the extent or nature of his experiments, but gives only the conclusions and the discussion of the theory, of which the following is a free translation:

As compared with feeding hay alone, hay and an easily digestible carbohydrate gave a milk poorer in fat. When the hay ration remained practically the same, but large amounts of starch were fed in addition, there was no appreciable increase in the milk yield, but a noticeable decrease (about 0.7 per cent) in the fat. Fourteen pounds of starch was fed with 16 lbs. of hay, the starch being treated with malt and given as a sweet drink. The starch is probably changed to body fat

but not to milk fat. This agrees with the investigations of Kühn and Stohmann. Likewise, increasing the amount of protein in the food resulted in an increase in the milk production or prevented a shrinkage with advancing lactation, but gave no one-sided increase in the fat content. The fat content was practically the same when 4 lbs. of rice gluten containing 71 per cent of protein was fed as when hay was fed alone. The addition of fat to hay materially increased the fat content of the milk, provided the fat was in form to be taken up and digested. When sesame oil, linseed oil, or tallow was added to the ration, in the form of emulsions thoroughly mixed with the drinking water, the milk contained as high as 5.8 per cent of fat. When 1.5 to 2 lbs. of linseed oil was added to 18 to 22 lbs. of hay the milk averaged 5.24 per cent of fat for 4 days; when 1 to 2 lbs. of tallow was added to the same amount of hay the milk contained from 4.24 to 5.5 per cent of fat, the average for 8 days being 4.7 per cent.

This is contrary to the results of experiments by M. Fleischer, G. Kühn, and Stohmann. In the latter cases the addition of oil resulted in a slight decrease in the fat, while in the present case it resulted in a material increase in the fat content of the milk. This may be explained by the fact that formerly the oil was mixed with the fodder, in which form it is not digested and causes a disturbance of the digestive functions.

In Fleischer's experiment the addition of 4 lbs. of flaxseed resulted in no increase in milk fat because the fat is not digested from whole flaxseed. But in Stohmann's experiment, in which ground flaxseed extracted of fat was fed in place of fat linseed cake, the fat content of the milk decreased from 0.6 to 1 per cent. This is believed to furnish a striking illustration of the effect of a ration poor in fat as compared with one rich in fat. This experiment, made in 1866, has previously been overlooked in discussing this question.

In feeding a ration rich in fat the author believes that the increase in fat content of the milk does not take place by a transmission of the fat of the food to the milk. With such feeding the content of volatile fatty acids in the milk fat decreased in some cases nearly one-half. For instance, the Meissl number dropped from 25.32 to 15.7 when 16 lbs. of hay and 2 lbs. of sesame oil were fed; and the fat in the milk from cows which were fed 60 to 65 liters of corn-distillery slop showed only 15.5 per cent volatile fatty acids. From this it might be concluded that the sesame oil and corn oil, which are nearly free from volatile fatty acids, were transmitted to the milk; but if this had been the case the melting point of the butter made from this milk would have been materially decreased. On the contrary, it was considerably increased, being 41.5°, as compared with the average melting point of butter of 36°, while that of the oils is below 0°.

As the result of the author's experiments, as well as of the examination of milk from herds to which large amounts of corn-distillery refuse

or the residue from the manufacture of starch from corn were fed, it was found, as a rule, that food rich in oil did not give, as was expected, a milk fat with a low melting point, but instead one with an uncommonly high melting point. In other words, such food did not give a soft butter, as is generally stated, but a hard butter instead.

The fat of the food does not go directly into the milk, but forces into the milk body fat, *i. e.*, tallow, and thus indirectly increases the quantity of milk fat. Normal butter fat is certainly a product of the activity of the lacteal glands. Its amount can therefore not be materially increased by the manner of feeding without increasing the secretion of milk as a whole. Unlike the carbohydrates and protein, the fat of the food can materially increase the fat content of the milk, but only by the body fat, produced from the carbohydrates, being transported to the milk, whereby the fat of the food is probably consumed to keep up the oxidation in place of the body fat.

From the results obtained the author believes that in purchasing concentrated feeding stuffs for cows special weight should be laid upon high fat content. While at present the protein is rated at about one and a half times the money value of fat, in future the fat of concentrated feeding stuffs will be considered of at least equal value to protein, and probably of higher value. In concentrated feeding stuffs the fat should be guarantied separately. The oil factories should be induced to furnish oil cakes with a higher fat content, as was formerly the case before the methods of extraction were perfected.

These facts, the author believes, throw a new light upon the secretion of milk, furnishing a further ground for the belief that the constituents of milk result from the breaking down of organized tissue. On a ration poor in fat the milk fat is newly formed fat of a special kind, distinguished from other animal and plant fats by its higher content of volatile fatty acids. On a fat-free ration only this "normal" fat (*i. e.*, that resulting from the breaking down of milk-producing tissue) can appear in the milk, and its amount can not be increased by adding fat-producing nutrients (carbohydrates) or protein to the food. Fat-free food can increase the production of milk fat only by increasing the tissue which yields milk by decomposition, in which case the other milk constituents are increased in the same proportion as the fat. The feeding of large amounts of carbohydrates can increase the body fat, but not the milk fat, since they do not contribute to the formation of milk-producing tissue; when fed in large quantities with a ration which is not rich in protein, as hay, they decrease the fat content of the milk, because they diminish the proportion of protein in the ration, that is, the tissue-forming material (glandular tissue and white blood corpuscles). The fat of the food alone is capable of bringing about a one-sided increase in the fat content of the milk; it causes a transmission of the body fat to the milk without itself going into the milk. The greater the fat content of the food, the larger the proportion of milk fat which is derived

from the body fat, that is, tallow; and in the same proportion, as a rule, the lower the content of volatile fatty acids in the milk fat the higher its melting point.

Feeding tests, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 203–236*).—These were made during the winter of 1895–'96, using 31 cows in all. The trials covered 5 periods of 4 weeks each, the first 10 days in each case being regarded as preparatory and the last 18 days experimental. Data are tabulated for each of the separate trials, including the yield and composition of the milk of each cow; the composition of the corn silage, beets, carrots, corn meal, wheat bran, corn-oil cake, Atlas gluten meal, cotton-seed bran, and mixed feed is given, and a record of the barn temperature.

Corn silage vs. beets.—Four cows were alternated for 4 weeks on silage and beets fed *ad libitum* in addition to a constant ration of grain and hay.

"More dry matter was eaten when beets were fed than when corn silage was fed [but there was a nearly equivalent increase in the yield during the beet period].

"One hundred pounds of dry matter, both in the entire ration and in the experimental fodder, gave slightly larger returns when silage was fed than when it was replaced by beets, making 1 per cent more milk and total solids, and 4 per cent more butter fat. These differences are too small to lay stress upon, and apparently in these tests the dry matter of each fodder had about equal feeding values.

"There was no material change in the quality of the milk.

"Inasmuch as the dry matter of corn silage is but 66 per cent digestible, while that of beets ranges from 78 (mangel-wurzels) to 94 per cent (sugar beets) in digestibility, it follows that a pound of digestible dry matter in corn silage gave larger returns in these tests than a pound of digestible dry matter in beets.

"The incomplete digestion of the hay, observed during the beet-feeding periods, should be borne in mind in this connection as probably a not unimportant factor in the results."

The results obtained in similar comparisons at the Ohio,[1] Pennsylvania,[2] and Vermont[3] stations are cited.

"The results of the tests now under discussion appear to be in line with those hitherto made, and they may be all summarized as follows:

"(1) Beets cost more to grow, harvest, and store, yield less per acre, and produce at best no more and no better milk than corn silage.

"(2) Beets are much liked by cows and serve an excellent purpose, when fed in small quantities, as an appetizer. They serve to promote the general health and digestion, particularly if no other succulent food is at hand."

Corn silage vs. carrots.—Three cows were alternated on silage and carrots fed *ad libitum* for 4 periods. These were fed with a constant ration of hay and mixed grain.

"The milk made while carrots were fed was somewhat thinner than that given when silage was fed.

"One hundred pounds of dry matter in the entire ration during carrot feeding

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[1] Ohio Sta. Buls., Vol. II, 3; Vol. III, 5; No. 50 (E. S. R., 1, p. 141; 2, p. 247; 5, p. 887).

[2] Pennsylvania Sta. Rpt. 1890, p. 113; Bul. 26 (E. S. R., 3, p. 716; 6, p. 446).

[3] Vermont Sta. Rpt. 1894, p. 148 (E. S. R., 8, p. 86).

produced 4 per cent more milk and total solids, but no more butter fat than when silage was fed. One hundred pounds of dry matter in the experimental fodder was apparently of equal value in either ration for milk and total solids; that from carrots, however, produced 4 per cent less butter fat. These differences are so small that no stress can safely be laid upon them, and apparently in these tests the dry matter of corn silage and carrots had essentially equal feeding values.

"Since the dry matter of carrots is practically all digestible and that of corn silage but two-thirds digestible, it follows that 100 lbs. of digestible dry matter in the corn silage gave larger returns in these tests than 100 lbs. of the same in the carrots."

Beets vs. carrots.—Two cows were alternated on beets and carrots fed *ad libitum* for 4 periods. Silage was fed in addition to the roots in the last 3 periods. The beets did not last quite through the fourth period.

"(1) In spite of 10 per cent less total dry matter eaten in the form of carrots, the production of milk, total solids, and butter fat increased 4 per cent.

"(2) In spite of 34 per cent increase in the total dry matter eaten in the form of beets, but 3 per cent more milk, 4 per cent more total solids, and 1 per cent more butter fat were produced.

"(3) A carrot ration with 18 per cent less dry matter than a beet ration and a third less dry matter in the form of roots produced equally good returns.

"(4) There was no change in the quality of the milk.

"(5) One hundred pounds of dry matter in the carrot ration yielded about a fifth greater product than the beet ration, while 100 lbs. of dry matter in the carrots yielded about two-fifths greater product than did the same amount of dry matter in the beets.

"(6) The dry matter of both beets and carrots is practically all digestible; hence, in these tests the carrots far surpassed the beets in feeding value, either on the basis of dry matter or of digestible matter."

Corn-oil cake vs. corn meal and bran.—These materials were compared with 6 cows in 5 periods of 4 weeks each, with the following results:

"(1) Seven per cent more milk and milk ingredients were given when an equal weight of dry matter in the shape of corn-oil cake was substituted for equal parts of corn meal and bran.

"(2) Nine per cent less milk and milk ingredients were given when an equal weight of dry matter in the shape of equal parts corn meal and bran was substituted for corn-oil cake.

"(3) Eight per cent more milk and milk ingredients were given when an equal weight of dry matter in the shape of corn-oil cake was substituted for equal parts of corn meal and bran.

"(4) There was no change in the quality of the milk as a result of the change in ration.

"(5) One hundred pounds of dry matter in the shape of corn-oil cake, in the place of an equal amount of dry matter in the form of equal weights of corn meal and bran, increased the yield of milk and milk ingredients one-twelfth."

Atlas gluten meal vs. corn meal and bran.—Atlas gluten meal was compared with a mixture of equal parts of corn meal and bran on 6 cows for 20 weeks with the following results:

"(1) Three per cent increase in the total dry matter eaten in the form of Atlas gluten meal produced 16 per cent more milk, 18 per cent more total solids, and 20 per cent more butter fat.

"(2) Four per cent decrease in the total dry matter eaten in the form of corn meal and bran produced 11 per cent less milk and total solids, and 15 per cent less butter fat.

"(3) Three per cent increase in the total dry matter eaten in the form of Atlas gluten meal produced 15 per cent more milk, 16 per cent more total solids, and 19 per cent more butter fat.

"(4) There appeared to be a slight tendency toward richer milk when the Atlas gluten meal was fed. The ratio of fat to solids-not-fat was lowered as an effect of feeding this meal, it resembling the other richer glutens in this respect.[1] The change, however, is not large enough to have much practical significance.

"(5) One hundred pounds of dry matter in the form of Atlas gluten meal, in the place of an equal amount of dry matter in the form of equal parts of corn meal and bran, increased the yield of milk and total solids an eighth, and that of the butter fat a sixth.

"(6) Assuming the correctness of the coëfficient, the digestible dry matter in Atlas gluten meal proved far more efficient as a milk and butter producer in these tests than did that of corn meal and bran.

"(7) [Atlas meal] seems to be a safe form of concentrated feed. We have not had trouble in the matter of garget as with some regular gluten meals. [At $16 per ton] it is unquestionably the cheapest protein now upon the market."

Cotton-seed feed vs. corn meal and bran.—A comparison of these materials on 4 cows during 5 periods of 4 weeks each gave the following results:

"(1) One per cent increase in the total dry matter eaten (but 3 per cent decrease in that eaten in the cotton-seed bran), produced 3 per cent less milk and total solids, and 4 per cent less butter fat.

"(2) Two per cent decrease in the total dry matter eaten (but 1 per cent increase in that eaten in corn meal and bran), produced 2 per cent more milk, and 4 per cent more total solids and butter fat.

"(3) One per cent increase in the total dry matter eaten (but 2 per cent decrease in that eaten in cotton-seed bran), produced 2 per cent less milk, 3 per cent less total solids, and 4 per cent less butter fat.

"(4) There was no material change in the quality of the milk produced by the two rations.

"(5) One hundred pounds of dry matter in the form of cotton-seed bran produced less milk, total solids, and butter fat, than did an equal weight of dry matter as corn meal and bran. The differences, however, were not great.

"(6) Cotton-seed bran may be assumed to be about half digestible. This would make the digestible dry matter of cotton-seed bran much superior to that of equal weights of corn meal and bran.

"(7) Cotton-seed bran (or feed) does not appear from these results, which are similar to those obtained elsewhere[2] to be worth the price asked as a milk-making food."

Experimental error in feeding tests.—To study this 5 cows were fed a constant ration of hay, mixed grain, and silage during the period covered by the above experiments.

"A pound of total dry matter produced no more milk and butter at one time than at another, lactation stages being equalized. . . .

"Apparently if the animals for feeding tests are carefully selected, and a sufficient number are used, the 'experimental error' may be nearly disregarded. If but two or three animals are used, it will hardly be safe to dogmatically assert that fluctuations of the product are of necessity due to changes in the character of the feeding, unless they exceed 4 or 5 per cent of the larger product."

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[1] See Bulletin 48 of the station (E. S. R., 8, p. 972).

[2] Pennsylvania Sta. Rpt. 1894, p. 44 (E. S. R., 7, p. 985).

Record of the station herd for 1894–'95, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 187–191*).—The record is given of 17 cows for 2 successive years and of 30 cows for 1 year ending October 31, 1895. The average annual butter yield of the 17 cows was 369 lbs. in 1894–'95 and 314 lbs. in 1895–'96.

Four of the cows aborted, 1 ran farrow throughout the 2 years, and 3 others ran farrow for a year and a half or more.

"The other nine cows gave within 1 per cent as much milk and butter the second year as the first. The quality of the milk of these cows did not change (1894–'95, total solids, 14.63 per cent; fat, 5.34 per cent; 1895–'96, total solids, 14.71 per cent; fat, 5.35 per cent), while, as has been already pointed out in a previous article, the milk from the cows which aborted was decidedly richer. Two of the farrow cows gave somewhat richer milk during the second year, and two did not change its quality."

The maxima, minima, and averages of the 30 cows for 1 year are shown in the following table:

Record of dairy herd, 1894–'95.

	Yield of milk.	Composition of milk.		Yield of—			Cost of—		Value of butter at actual selling price.
		Total solids.	Fat.	Total solids.	Fat.	Butter.	100 lbs. of milk.	1 lb. of butter.	
	Pounds.	*Per ct.*	*Per ct.*	*Pounds.*	*Pounds*	*Pounds*		*Cents.*	
Lowest	3,083	12.27	3.74	449.4	161.1	187.9	$0.646	11.8	$44.04
Highest	8,437	16.40	6.67	1,095.8	396.2	462.2	1.407	23.1	108.62
Average	5,633	14.11	4.95	794.8	278.8	325.3	.936	16.2	76.40

"Excluding Rena Myrtle, whose feeding record is faulty, the averages are: Days in milk, 324; pounds of milk, 5,572; per cent of total solids, 14.19; per cent of fat, 5; pounds of total solids, 790.7; pounds of fat, 278.8; pounds of butter, 325.3. . . .

"Usually the cows giving the most milk and butter made it most cheaply, and those giving the least milk or butter made it at the greatest cost."

Miscellaneous dairy notes and experiments, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 83–102*).—The results are reported of 3 experiments in souring cream by the addition of hydrochloric acid and of vinegar to sweet cream.

"The hydrochloric acid sample churned in 10 minutes, the vinegar sample in 17 minutes, and the sweet cream from the separator in 12 minutes.

"All the butter made from cream to which hydrochloric acid had been added had a smell resembling that of rotten eggs. The vinegar samples had a vinegar flavor. There would seem to be nothing in the addition of these acids to cream to aid in the production of good butter."

Twenty-four tests were made during the summer on the loss in weight of milk standing in cans over night. In all 1,761 lbs. of milk was used, and this shrunk 7.25 lbs. from standing over night. The average percentage of fat in the milk at night and the next morning was practically the same.

An experiment in making whey butter in May gave a butter not quite up to the mark in grain and body, but otherwise of very fair quality.

"When butter is scarce and dear it may pay to separate the cream from the whey and churn it, but it would not pay at present prices."

A simple device for keeping the cheese curing room cool during hot weather is described.

Several comparisons are given of the "dram" test and the Marschall test for determining the ripeness of cream in Cheddar cheese making. Several objections are made to the latter test.

The results of a test of 24 cows at the Provincial Dairy Show are discussed and tabulated.

Accounts are quoted of the use of milking machines in England and Scotland, and a report is given of a 7 or 8 day test of the Thistle milking machine on the station herd.

"We used our portable farm engine in making the test, and we found that a man and a boy could milk 26 cows in from 20 to 26 minutes. I think it might be arranged so that one man could milk nearly as many in the same time.

"We weighed and tested the milk from each cow as usual, and found about the same quantity as was obtained by hand, but a marked fall in the percentage of fat, due, we have no doubt, to the excitement caused by the noise of the machine and the presence of a large number of people in the stable. As the cows became accustomed to the noise, the percentage of fat gradually increased."

An instance of the bad effect on cheese of feeding brewers' grains to cows is given. One of the patrons who furnished milk for the cheese-making experiments fed brewers' grains during the summer.

"As a consequence, part of our August cheese and most of the September had a flavor like yeast. This flavor continued for nearly two weeks after the feeding of the grains was discontinued, and I would warn all factory men and all patrons against allowing any of these grains to be fed to cows giving milk for cheese or butter making. It is one of the worst flavors I ever experienced in cheese, and experts who have sampled them pronounce the flavor a peculiarly bad one."

Other subjects discussed are the low percentages of fat in milk in 1895; centrifugal drying of cheese curds; tests of the Bartlett aërator and cooler, a steel churn, tub lined with paraffin wax, glass-jar package with tin cover, and a sample of Fairlamb rennet; brewers' grains for dairy cows; flytraps and preparations to keep off flies; and a popular article on farm butter making.

Variations in milk, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 157–186*).—Data are compiled from observations at the Minnesota,[1] New York State,[2] and Vermont[3] stations with reference to the variations in quantity and quality of milk from month to month, during the period of lactation, and from year to year; the quality of the milk of "strippers;" the best time to test a cow; and the effect of abortion. The data cover over 100 lactations of cows of many breeds.

"The data of the Vermont station is based upon 47 separate lactations (mainly of Jerseys and their grades and of Ayrshires), the New York data upon 44 separate lac-

[1] Minnesota Sta. Rpt. 1893, p. 314; Bul. 35, p. 41 (E. S. R., 6, pp. 749, 928).

[2] New York State Sta. Rpt. 1894, p. 268 (E. S. R., 8, pp. 634, 635).

[3] Vermont Sta. Rpt. 1892, p. 89 (E. S. R., 5, p. 320).

tations (American Holderness, Ayrshire, Devon, Guernsey, Holstein, Jersey, and Shorthorn), and the Minnesota data upon 17 separate lactations and cows (Jersey, Guernsey, Shorthorn and their grades, Polled Angus, and Grade Holsteins)."

The following deductions are taken from the author's summary:

"*Monthly variations during the period of lactation.*—The average spring cow rapidly betters the quality of her milk, beginning about five months after calving; the summer cow starts in as early as the third month, while the fall cow maintains fairly even quality throughout her lactation period, seldom improving it more than 0.5 per cent in fat content. The percentage of solids-not-fat also is most uniform month by month in the milk of the fall cow. The percentage of solids-not-fat in the milk of spring cows seems to lessen somewhat in the summer time.

"The average fall cow 'holds out' [in yield] as a rule better than the average spring cow, and, in the records now under discussion, as a rule gave larger yields.

"The gross yields [of butter] of spring and fall cows in the Vermont herd were the same, but in the New York and Minnesota herds, the average fall cow outstripped the average spring cow.

"The Vermont fall cow held up the evenness of butter production better than the spring cow. Little, if any, difference was seen in this respect in the other herds.

"*Extreme variations in quality during the period of lactation.*—The greatest monthly variation in the quality of the milk of 115 cows was 3.06 per cent fat, the least 0.33 per cent fat. The widest difference involved a change from 26.4 lbs. of milk to 14 lbs. of milk to a pound of butter. The average variation was 1.26 per cent fat. The average monthly variation of spring cows was 1.62 per cent fat; of fall cows, 1.08 per cent fat; of summer cows, 1.25 per cent fat. . . .

"Two-thirds of the Vermont and Minnesota herds gave thinnest milk during the first 2 months, and two thirds of the New York during the first 4 months. Ninety per cent of the Vermont and Minnesota cows gave their richest milk after the seventh month. Sixty per cent of the New York cows gave their richest milk before the eighth month. The arbitrary limitation of the New York records to a 10 months' lactation may partially explain this.

"*Variations in quality and quantity of milk from year to year.*—But 6 of 43 cows changed 10 per cent in quality in successive years. Such slight change as was made was for the better in two-thirds of the cases. Quantity changes are too dependent upon feeding, etc., to admit of deductions being drawn.

"*The quality of the milk of strippers.*—The milk given during the last few weeks before going dry is richer in fat and solids-not-fat, and of a higher specific gravity than the average of the milking period, provided the cow has been in calf for 2 months or more. This is not so surely true if the cow goes dry when farrow or when but recently served.

"*When to test a cow for quality and quantity of milk.*—A large number of comparisons show that the average quality of the milk of the entire year may be found with considerable accuracy by testing 2 composite samples, taken in either of two ways.

(1) Spring cows.—First sample taken 6 weeks after calving, and second from 6½ to 7½ months after calving.

"Summer cows.—First sample taken 8 weeks, and second one from 6 to 7 months, after calving.

"Fall cows.—First sample taken from 8 to 10 weeks, and second from 5½ to 7 months, after calving.

"(2) By analyzing 2 composite samples taken 2 weeks apart, date of taking in case of spring and fall cows to be 6 months after calving, and in case of summer cows to be 3 to 5 months after calving.

"Quite close approximations to truth may be obtained by weighing the milk during 4 days in the middle of each month and calculating the total yield by multiplication. In 43 per cent of the cases, calculation was within 2 per cent of truth. Butter

yields calculated in this manner and by using 2 Babcock tests came close enough to the truth for most purposes.

"*Effect of abortion on quantity and quality of milk.*—The effect of abortion was found to be: (1) A shrinkage of over one-third in milk yield, (2) a gain of one-tenth in quality, (3) a shrinkage of nearly one-third in butter yield, (4) a more even quality of milk throughout the milking period."

Experiments in creaming and butter making, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 60–66*).—Fifteen trials were made during October in setting milk in shallow pans, 20 lbs. of milk being set in a warm place and 20 lbs. in a cool place. The average temperature of the skim milk from the former was 54.1° and it contained 0.45 per cent of fat; and from the latter 44.1° and 0.39 per cent of fat.

"For three years we have had better results in creaming milk with shallow pans set in a cool room than in setting milk in these pans in a warmer place. We are satisfied that it is a mistake to carry milk in shallow pans into the pantry or kitchen in order to keep the milk warm for the cream to rise. A nice, cool, milk cellar where the milk will not freeze is much better—better in order to get the cream to rise, and better for the flavor of the butter. . . .

"From April to December, 22 trials were made, comparing 12, 24, and 36 hours' setting of milk in deep cans in ice water. During the summer months 12 hours' setting gave good results, but in November and December the skim milk from 12 hours' setting contained over 0.5 per cent of fat. The 24 and 36 hours' setting had considerably less."

In 10 comparative trials during May, July, and August in setting milk in deep cans in ice water so as to reduce the temperature of the milk to 41.4°, 46.7°, and 52.4°, respectively, the percentage of fat in the skim milk increased from 0.21 in the first case to 0.71 per cent in the last case.

"In 9 experiments made with 270 lbs. of milk brought to the dairy by patrons furnishing milk for the cheese department, which had been hauled some three or four miles before being set under conditions similar to the above, the loss of fat in skim milk was 0.25 per cent from milk at 40.5°; 0.44 per cent from milk at 46.6°, and 0.65 per cent from milk at 51.6°."

Twenty-eight comparative trials were made from April to October in which the milk to be separated by the Alexandra separator was heated to average temperatures of 82.2°, 97°, 107.7°, and 118.2°, respectively.

"The results were that the higher temperature of the milk at separating showed (1) less loss of fat in the skim milk (feed and speed of the machine remaining constant as far as possible in all the trials); (2) a higher percentage of fat in the cream, and (3) in the case of the Alexandra separators, the cream was smoother. The butter made from the samples of cream separated at the different temperatures was quite similar in quality."

Trials of diluting the cream with from 1 to 6 times its volume of water and running it through the separator a second time "did not improve the quality of the butter—in fact it rather injured the body of the butter and did not improve the flavor."

Sixteen trials were made from April to October with an Alexandra

separator in separating lots of milk averaging 4.18 and 3.3 per cent of fat. In general "the richer milk did not produce a great deal more volume of cream than the poorer milk, but the cream contained a higher percentage of fat."

The results are tabulated of a comparison of the creaming of milk by separator, in deep setting, and in shallow pans, each month from April to December, and the results obtained in 3 years' experiments are discussed.

"During 1893 and 1894 the position of the methods, as regards completeness of skimming, quantity of butter made, and quality of butter was: Separator first, deep setting second, and shallow pan third. This is the relative standing for 1895 also. . . .

"As to the quality of butter produced from the three methods, it may be said that there was not much difference in them during the cooler weather. In hot weather the shallow-pan butter was not so good, but at other times it compared favorably with the other two. Taken for the nine months, the separator butter was slightly better in quality, although not always so."

Experiments in making sweet-cream butter had been carried on at the station for 3 years previous, and in 1895 18 trials were made.

"Our results have been practically the same throughout, viz, that butter can be made from sweet cream, which will suit a certain class of customers, who like mild, fresh, creamy flavored butter; but by the majority of persons in Canada ripened-cream butter is liked better. Other points we have learned are:

"(1) We must churn sweet cream at a very low temperature (45° or below) in order to obtain all the butter. Churning at ordinary temperatures means a great loss of fat in the buttermilk. Cream rich in butter fat (25 to 30 per cent) gives best results.

"(2) Sweet-cream butter does not possess keeping quality the same as ripened-cream butter. We have found that it quickly goes off in flavor and does not improve or take on the flavor of ripened-cream butter, as claimed by some.

"(3) The temperature of the cream usually rises about 10° in the process of churning, indicating that the low temperature is not suitable for bringing the butter (yet necessary to start with) in order to gather all the particles of fat."

In a number of trials of different starters used for ripening cream "none produced so marked an effect on the flavor of the cream and butter as Conn's Bacillus No. 41."

One experiment was made each week during 1895 in packing the butter into tubs without washing and in washing once and twice. As a result the author recommends little or no washing where the butter is to be made into pound prints and consumed at once. Where packed in tubs the unwashed butter did not retain its quality quite as well, but the author believes that "many makers are spoiling the flavor of their butter by too much washing."

To compare the oil-test churn with the actual yield of butter 27 trials were made during July, August, and September.

"The total amount of butter credited in these churnings by the oil-test churn was 575.94 lbs., compared with 592.34 lbs. as the actual yield, a difference of 16.4 lbs. . . .

"Only three times out of the 27 trials did the oil test credit more than the actual yield from the churn."

Tests of dairy apparatus, J. L. HILLS (*Vermont Sta. Rpt. 1895, p. 192*).—This is a continuation of the test of steam consumption of separators given in the Annual Report of the Station for 1894, p. 151 (E. S. R., 8, p. 88). A series of tests were made with the DeLaval Alpha Belt separator under conditions as nearly similar to those in previous tests as practicable. The results of these tests are tabulated and are compared with those previously reported.

"It appears that in these tests the Alpha Belt machine used but about two-thirds as much steam as the United States Belt separator to separate the same amount of milk, under as nearly similar conditions as were obtainable, and that the DeLaval Turbine separator was much more wasteful of steam than either of the others, a condition which appears characteristic of steam motor machines in general."

Cheese producing power of milk of varying percentages of fat, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 19–33*).—Experiments are reported with the milk of the college herd and that delivered at two cheese factories and single tests with medium and very rich milk.

Dairy tests (pp. 20–27).—These tests lasted from May until October, and were a continuation of the work of the previous year (E. S. R., 7, p. 715). Data are given as to the percentages of fat and casein in the milk by months, the composition of green and cured cheese and of whey from medium and rich milk, the distribution of constituents in cheese making, and yield of cheese from milk containing different percentages of fat. Arranging the analyses of milk into groups according to the percentage of fat shows that "with the increase in fat there is a continuous decrease in the quantity of casein per pound of fat."

"This fact, together with the occurrence in most groups of slightly higher percentages of casein as the groups increase in fat, appears to me to demonstrate beyond all question that increases in percentages of fat are not accompanied by proportional increases in percentages of casein in milk; but that the increases in percentages of casein are proportionately less than the increases in percentages of fat."

The yield of cured cheese in relation to the casein and fat in the milk is shown in the following table:

Yield of cured cheese from rich and medium milk.

Months.	Lot L (rich milk).				Lot H (medium milk).			
	Fat.	Casein.	Cured cheese.		Fat.	Casein.	Cured cheese.	
			Per pound of fat.	Per pound of fat and casein.			Per pound of fat.	Per pound of fat and casein.
	Per cent.	*Per cent.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*
May	3.291	2.222	2.713	1.619	4.155	2.385	2.497	1.592
June	3.203	2.326	2.776	1.615	3.963	2.459	2.548	1.564
July	3.091	2.415	2.870	1.598	3.874	2.467	2.525	1.534
August	3.050	2.359	2.840	1.598	4.036	2.489	2.455	1.522
September	3.244	2.454	2.755	1.568	4.248	2.701	2.445	1.495
October	4.410	2.451	2.747	1.614	4.285	2.724	2.515	1.540

"The figures for each month are averages of 12 to 13 distinct tests on different days. This comparison shows that, while the medium milk yields nearly 0.3 lb. more cheese

per pound of fat than the rich milk, the medium milk yields only 0.06 more cheese per pound of fat and casein than the rich milk. . . .

"The fat and casein together never fail to determine, very nearly, the cheese-producing power of milk, whatever its percentage of fat. . . .

"For each month the calculated yield [on the fat basis] in the medium milk is less than the actual yield, and in the rich milk is more than the actual yield. For the entire season the calculated yield of cheese from the 22,194.5 lbs. of medium milk is 109 lbs. less than the actual yield; and the calculated yield from the 21,894.5 lbs. of rich milk is 109 lbs. more than the actual yield. These differences between the actual and calculated yields of cheese follow from or are due to, the casein in milk not increasing in the same ratio as the fat."

Both the green and the cured cheese made from milk with a medium fat content contained higher percentages of moisture and casein each month but lower percentages of fat than the cheese made from richer milk. The whey from the richer milk contained a higher percentage of fat each month than that from the medium milk, but the difference in casein was very small. "In the process of curing, cheese from the medium milk loses higher percentages of moisture, fat, and casein than cheese from the rich milk."

The conclusions from these dairy experiments are given as follows:

"(1) A given weight of rich milk makes more cheese than an equal weight of medium or of poor milk.

"(2) The casein per pound of fat is greater in medium than in rich milk.

"(3) The percentage of casein is higher in rich milk than in poor or in medium milk in averages of several samples; but, in single samples, a decrease in casein may accompany an increase in fat, and *vice versa*.

"(4) Casein in milk does not increase in the same ratio as the fat in poor, medium, or rich milk.

"(5) A medium milk yields a greater weight of cheese per pound of fat contained in it than a rich milk.

"(6) There is a little more fat lost in whey from a rich milk than from a medium milk.

"(7) Cheese in curing 30 days loses from 4 to 5.5 per cent of its green weight.

"(8) Cheese from medium milk loses in curing a slightly higher percentage of its green weight than cheese from rich milk."

Marden and Rockwood tests (pp. 27–30).—Samples of milk and green cheese were taken weekly from the Marden and Rockwood cheese factories during the whole season for analysis. The results of these analyses and the calculations made from them are tabulated. "The results obtained in the tests confirm every conclusion reached in the tests made with the milk from our own dairy."

As to the method of paying for milk at cheese factories, the author says:

"The fat basis of distribution is in the right direction. It considers the quality as well as the weight of milk. But by this method, since casein in milk does not vary as the fat, it makes a very great distinction in favor of the rich milk. . . .

"This method gives the advantage to the richer milk, and discourages watering and skimming. For these and other reasons it is commendable. But owing to the facts (1) that the casein of milk, as well as the fat, enters into the cheese, influencing, like fat, its amount and its quality, and (2) that the variations in the percentages of the casein in milk are not in the same ratio as those in the percentages of fat, the

fat basis of distribution gives too great an advantage to the richer milk. Two being somewhat in the neighborhood of the average percentage of casein, particularly in milk between 3 and 3.5 per cent of fat, its addition to the fat reading considerably reduces the advantage given, by the fat basis alone, to the richer milk. But the fat + 2 method does not recognize any difference in the percentages of casein in poor, medium, and rich milk. For this reason, as in our dairy tests for May, a poor milk may be credited with more cheese than the milk produces, and the rich milk with less cheese than it produces, and *vice versa*. The fat and casein method, using addends to calculate casein, distributes the cheese, as in the dairy tests, fairly to all qualities of milk, making due allowance for quality and quantity of cheese."

The results of 5 single tests which are reported in making cheese from medium and very rich milk "reveal nothing conflicting with former conclusions."

Ratio of fat to casein in individual cow's milk (pp. 31–33).—Data are given for observations of several weeks' duration on the milk of 4 cows, the yield and composition of the milk and the quantity of casein per pound of fat being given.

Experiments in the manufacture of cheese, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 44–60*).—The data are given for experiments on the relation of fat in milk to the quantity and quality of cheese. These experiments were continued during the season from May to December, and covered on the average 3 days of each week. The data are quite fully tabulated, but no conclusions are given, as the cheese was not fully ripened when the report was issued. The conclusions from this work are given in Bulletin 102, noticed below (p. 1030).

Experiments are also reported on the effect of dipping spring, summer, and fall curds at different stages of acidity; effect of salt on curds from normal, rich, and poor milk; effect of temperature in cooking curds, and effect of using different quantities of rennet in making spring cheese. The principal conclusions, where any were reached, are given below:

"Further trials are needed to settle the point as to the right amount of acid to give spring curds. We would advise about one-eighth of an inch. . . .

"The results indicate that rich milk curds should be salted more heavily than poorer milk curds. The tendency of cheese made from rich milk is toward a 'pasty' texture and poorer keeping quality. An extra amount of salt remedies this to some extent. Curds from 4 per cent milk and over need to be salted at a higher rate than other curds. The quantity will vary with the season, the amount of moisture in the curd, and the length of time the cheeses are to be kept before they are placed on the market. . . .

"The experiments made indicate that one or two degrees higher temperature in cooking would improve the texture of cheese made from rich milk, say milk containing 4 per cent of fat and over, although some of the cheese scored higher, at a lower cooking temperature. If the usual temperature for cooking is 98°, we would recommend cooking to 99 or 100° when making up milk containing over 4 per cent of fat into cheese. The higher cooking tends to improve the body and texture and to overcome the tendency to pastiness in cheese made from rich milk. . . .

"In the experiments where but 1 and 2 oz. of rennet per 1,000 lbs. of milk were added, the time required for coagulation was too long and considerable cream rose to the top. As a consequence the percentage of fat in the whey was high, 0.3 and 0.2 per cent; and the yield of cheese was less, being half a pound less in the case of

1 oz. and a quarter of a pound less where 2 oz. of rennet were used. This loss was on 300 lbs. of milk and would amount to considerable in a large vat. There also seemed to be less yield of cheese where the extra large quantities of rennet were used. and more loss of fat in the whey. . . .

"The best cheeses were made on April 5, when 3 oz. and 2½ oz. of rennet were used per 1,000 lbs. milk. These two cheeses the experts pronounced very good spring cheese."

Experiments in cheese making, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Bul. 102, pp. 31*).—*Relation of fat in milk to quantity and quality of cheese in the months of November and December, 1895.*—This is a continuation of the investigation reported above, covering the months of November and December. Data similar to that in the report noticed above are tabulated.

Summary of two years' work on the relation of fat in milk to cheese produced.—This is a summary of the work noticed above (p. 1029). In studying this question, during the two years cheese was made from 287 vats of milk, averaging 300 lbs. each, or 86,100 lbs. of milk altogether. The author believes the results warrant the following conclusions:

"(1) Whole milk is not valuable for cheese making in proportion to its weight or volume, as 100 lbs. of 3 per cent milk will make about 1½ lbs. less cheese than 100 lbs. of 4 per cent milk.

"(2) Whole milk does not produce cheese exactly in proportion to the butter fat contained in it, as 1 lb. of fat in milk testing an average of 3.23 per cent produced 2.78 lbs. of cured cheese, while 1 lb. of fat in milk testing an average of 4.2 per cent produced an average of 2.52 lbs. of cured cheese.

"(3) The yield of cheese is fairly uniform in proportion to the fat and casein contained in the milk, when the latter is represented by adding 2 to the percentage of fat. This method gives results slightly lower than the actual yield of cheese, for milk testing under 3.25 per cent of fat, and slightly above the actual yield, for milks testing over this percentage of fat.

"(4) Percentage of fat in the whey was greater from rich milk than from poor milk, but the loss of fat per 100 lbs. of cheese made did not differ materially until milk with over 4.50 per cent of fat was used.

"(5) The relation of the fat of the milk to the quality of the cheese produced is the most difficult point of all to settle, as there is so much difference of opinion as to what constitutes 'quality' in a cheese. It is difficult to get two judges to agree as to the number of points which cheese should be scored; and there does not seem to be a very definite relation between points scored and the market or money value. A cheese that would bring top price in one market might not do so in another. At present there is not enough discrimination made in cheese sold on the markets. All our cheese made at the College were sold for the same price each month.

"(6) The cheese made from poor milk had a tendency to become harsh in texture, which may be partially remedied by using less salt and leaving more moisture in the cheese. Rich milk has a tendency to produce cheese somewhat 'pasty' and 'slippery' in character, which may be partially remedied by the use of extra salt and by cooking one or two degrees higher than usual. The flavor, closeness, even color, and texture of a cheese are somewhat dependent upon the fat present in the milk and retained in the cheese; but with normal milk there are a number of factors equally important in the manufacture and sale of Cheddar cheese. Among these are (1) what may be called good physical qualities in the milk, such as smell and taste; (2) skillful making; (3) differences in the tastes of judges and consumers.

"(7) The percentage of fat in milk plus 2 is a fair basis upon which to distribute proceeds among patrons of cheese factories."

Effects of salt, temperature, rennet, and acid in cheese making.—The results are tabulated and discussed of experiments in using different amounts of salt, adding the rennet at different temperatures, using different quantities of rennet, milling the curd at different stages of acidity, and putting the curd to press at different temperatures.

Three experiments were made in using from 2 to 4 lbs. of salt per 100 lbs. of curd.

"The difference in the quality of the cheese made was not very marked, except in the case of the curd salted at the rate of 4 lbs. of salt per 100 lbs. of curd (December 18—3.5 per cent of fat in milk), which was pronounced a very 'harsh' cheese."

Seven experiments were made in which the rennet was added at from 70 to 95° F.

"These experiments indicate that above 86°, up to 95°, each increase of 1° in temperature in the milk will decrease the time required for coagulation by 1 minute. Below 86°, down to 70°, each degree of fall in temperature increases the time required for coagulation by about 2 minutes, other things being equal. The effect of setting-temperature on the time from setting to dipping seems to be that a temperature below 86° requires a longer time before the curd is in a condition to 'dip,' as tested by the hot iron. Above 86°, in the two experiments made, there was little difference in the time.

"Perhaps the most important point of all was the extra loss of fat in the whey from setting at low temperatures. The loss was 0.5 per cent when set below 80°. There was a corresponding decrease in the yield of cheese from these temperatures. The effect on the quality of cheese did not seem to be very marked."

In regard to the effect of using different quantities of rennet—

"There is nothing special to report in these experiments, except that the extra rennet added coagulated the milk in much less time than the ordinary amount did; but the time required for coagulation with a given quantity of rennet in these months was larger than in the spring, though the milk was of similar ripeness, as indicated by the rennet test."

From the experiments made on this point a statement is given of the time required for coagulating at different seasons of the year with from 1 to 9 oz. of rennet per 1,000 lbs. of milk.

"The length of time from dipping to salting did not appear to be materially affected by the time or condition of milling within the range given. In other words, these curds were ready to salt in about the same length of time after dipping, whether milled early or late. The yield of cured cheese was very similar. . . . The quality of the cheese made on the same day was quite uniform throughout."

European dairying, H. H. Dean (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 73–83*).—Notes and suggestions are given as a result of a short trip in Europe. These are based largely on observations made in England and Denmark and relate to the demands of the butter trade, ways in which these are being met by other countries, the methods practiced in Denmark, butter exhibitions, and milk supply for cities. In these lines valuable information and suggestions are given.

The principal suggestions made for Canada are that some distinctly Canadian packages be used for putting up first-class dairy products; that the dairy trade be

developed in tinned butter for warm countries and for use on board ships, in the cold process of condensing milk and the freezing of milk for ship use in summer, in the manufacture of fancy cheese for home markets, and in supplying Cheddar cheese to countries where it is little known or butter where butter is made a specialty and fancy cheese is imported at a high price; restriction of the sale of margarin and all butter imitations, filled cheese, etc., and the establishment of dairy exhibitions similar to those held in Denmark.

Feeding skim milk to cows, J. JOERGENSEN (*Landmansblade, 29 (1896), pp. 283–285*).—Favorable practical experience with Lindström's method of feeding skim milk (E. S. R., 8, p. 248).

Trials with feeding coagulated skim milk to milch cows, A. LINDSTRÖM (*Tidskr. Landtmän, 17 (1896), pp. 212–214, 224–230*).—Favorable results were obtained in feeding 4 to 5 kg. (9 to 11 lbs.) of skim milk per day per head. For method of preparation see E. S. R., 8, p. 248.

Feeding coagulated skim milk to milch cows. A. LINDSTRÖM (*Nord. Mejeri Tidn., 11 (1896), Nos. 12, pp. 135, 136; 13, pp. 147, 148*).

Yield and feed of the dairy herd at Kalnaes agricultural school (Norway), 1895, K. DOEHLEN (*Norsk. Landmansblad, 15 (1896), No. 25, pp. 297–302*).

Fast and slow milking, J. L. HILLS (*Vermont Sta. Rpt. 1895, pp. 193, 194*).—The results are tabulated of a trial with 8 cows, lasting 1 month and divided into 3 periods, the cows being milked fast in the first and last periods and slowly during the second period. There was a diminution in the yield of milk throughout the trial. "How much effect, if any, the slow milking had in lessening the yield can not be told because of the natural shrinkage due to the time of year."

A record of the dairy herd for 1895, H. H. DEAN (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 68, 69*).—A yearly record is given for 21 cows. "We still adhere to our standard of at least 6,000 lbs. of milk, or 250 lbs. of butter yearly. If a cow does not reach this standard, she must go."

The phosphates of the milk, C. BARTHEL (*Nord. Mejeri Tidn., 11 (1896), No. 28, p. 330*).

Pasteurization of the skim milk at coöperative creameries (*Landmansblade, 29 (1896), pp. 242, 243*).

A self-regulating pasteurization apparatus, V. HENRIQUES and V. STRIBOLT (*Landmansblade, 29 (1896), pp. 557–559; Norsk. Landmansblad, 15 (1896), No. 46, pp. 536–539, ill*).

The use of refrigerating machines in the dairy industry (*Nord. Mejeri Tidn., 11 (1896), Nos. 24, pp. 279–280; 25, p. 290*).

The Alpha churn (*Nord. Mejeri Tidn., 11 (1896), No. 16, pp. 183–185, ill.*).—A new Swedish churn, invented by an Australian dairyman, R. E. Svenden, and manufactured in Sweden.

Swedish coöperative creameries, Y. MELANDER (*Tidskr. Landman, 17 (1896), pp. 320–323, 348–354*).

A new method of condensing milk, J. SEBELIEN (*Norsk Landmansblad, 15 (1896), No. 46, pp. 535, 436*).—Treats of Declaux's suggestion to condense milk by successive freezing and thawing, separating out the ice crystals by centrifugal force.

On casein and the action of rennet on cow's milk, F. SCHAFFER (*Nord. Mejeri Tidn., 11 (1896), Nos. 19, p. 219; 20, 231, 232; 21, 244*).

Traveling dairy, F. J. SLEIGHTHOLM (*Ontario Agl. College and Exptl. Farm Rpt. 1895, pp. 69–72*).—A report of the work of the traveling dairy in 1895. "In the course of the past season the traveling dairy has addressed, at 120 meetings, about 4,000 people, made upward of 1,000 lbs. of butter, and tested about as many samples of milk."

On the regulation of the sale of milk from a hygienic point of view, E. ALMQUIST (*Kgl. Landt. Akad. Handl., 35 (1896), No. 4, pp. 209–218*).

AGRICULTURAL ENGINEERING.

A new plan for the construction of a storage cellar, W. B. ALWOOD (*Virginia Sta. Bul. 58, pp. 163–168, figs. 3*).—A cellar for the winter storage of fruits and vegetables has been constructed at the station, the essential features of which are described as follows:

"(1) A cellar excavated into a gently sloping hillside, carried into the bank far enough to place the cellar room entirely below the surface of the earth and yet give opportunity to enter the cellar easily by an inclined way from the lower side of the slope; (2) a flue leading out from near the center of the floor of the cellar room, along the bank of the hillside for a considerable distance, with sufficient fall to make it act both as a drainpipe and a fresh-air flue; (3) ventilating flues placed at each end of the cellar room, or elsewhere as desired, and rising to the height necessary to give a sufficient draft to carry off rapidly the air from the cellar room whenever ventilation is desired."

A trial of this cellar has given quite satisfactory results as regards ventilation and uniformity of temperature.

Brick paving for country roads (*U. S. Dept. Agr., Office of Road Inquiry Circ. 25, pp. 7, figs. 6*).—This is an account, taken principally from the Monmouth Daily Review and the Engineering News, of the successful use in road making of vitrified brick made from shale in Monmouth, Warren County, Illinois. The narrow-strip method of road construction is illustrated and discussed.

STATISTICS.

Ninth Annual Report of Georgia Station, 1896 (*Georgia Sta. Rpt. 1896, pp. 593–598*).—The report includes very brief notes by the director upon progress of work at the station, a list of publications issued during the year, and a financial statement for the fiscal year ending June 30, 1896.

Ninth Annual Report of Maryland Station, 1896 (*Maryland Sta. Rpt. 1896, pp. 213–230*).—This includes a report by the director upon bulletins issued, general progress of the station, and experimental work in the agricultural department; notes upon investigations by the chemist, horticulturist, entomologist, physicist, and veterinarian; and a financial statement for the fiscal year ending June 30, 1896.

Tenth Annual Report of Nebraska Station, 1896 (*Nebraska Sta. Rpt. 1896, pp. XXXII*).—Report by the director on the general management of the station, additions to the station personnel, station improvements and progress, and bulletins published during the year; outlines of work by heads of departments; and a financial statement for the fiscal year ending June 30, 1896.

Eighth Annual Report of New Hampshire Station, 1896 (*New Hampshire Sta. Bul. 40, pp. 76–94, figs. 4*).—Brief reports by the heads of departments on the work of the year, with lists of bulletins published and of donations received by the station, and a financial statement for the fiscal year ending June 30, 1896. Some work done by the entomologist is reported elsewhere (p. 1003).

Fifteenth Annual Report of Ohio Station, 1895 (*Ohio Sta. Rpt. 1895, pp. V–XLIII, figs. 2*).—Reports by the board of control, director, and heads of departments on the work of the year, parts of which appear elsewhere; announcement as to the scope of the station work; an inventory of the station buildings, with floor plans of the main building and of the dairy barn; lists of the publications issued and of the donations and exchanges received during the year; and a financial statement for the fiscal year ending June 30, 1895.

Ninth Annual Report of Tennessee Station, 1896 (*Tennessee Sta. Rpt. 1896, pp. 2-16, 19, 20*).—Brief reports by the heads of departments on the work of the year, with a bibliography of the station literature since its establishment in 1888, and a financial statement for the fiscal year ending June 30, 1896.

Reports of director and treasurer of Vermont Station, 1895 (*Vermont Sta. Rpt. 1895, pp. 5-36*).—Brief summaries of work of the station in different lines, list of available station publications, abstracts of Bulletins 45-49, and a financial statement for the fiscal year ending June 30, 1895.

Sixth Annual Report of Wyoming Station, 1896 (*Wyoming Sta. Rpt. 1896, pp. 30, and Appen., pp. 320*).—This includes brief notes upon the bulletins issued by the station during the year, plan of station work, financial statement for the fiscal year ending June 30, 1896, and reports by the director, agriculturist and horticulturist, botanist, chemist, geologist, physicist, meteorologist, and superintendents of substations at Lander, Sundance, Wheatland, and Sheridan. The appendix contains reprints of the bulletins issued during the year.

Index to Wyoming Station bulletins (*Wyoming Stat. Rpt. 1896, Appen., pp. 15*).—A reprint of Index Bulletin A of the station (E. S. R., 8, p. 637).

Report of the agricultural experiment station of Marburg, 1895-'96, T. DIETRICH (*Jahresber. landw. Vers. Stat. Marburg, 1895-'96, pp. 11*).—A summary account of the work of the year, including analyses of fertilizers and feeding stuffs, and accounts of tests of seeds (see p. 989).

Report of the chemical control station at Alnarp for 1895, M. WEIBULL (*Alnarp (Sweden), 1896, pp. 14*).

Report of the chemical and seed control station at Skara for 1894, O. NYLANDER (*Skara (Sweden), 1895, pp. 18*).

Report of the chemical and seed control station at Skara for 1895, O. NYLANDER (*Skara (Sweden), 1896, pp. 20*).

Sugar statistics (*Sugar Cane, 29 (1897), No. 334, pp. 277-279*).—Imports and exports of raw and refined sugars of sugar-producing countries, estimates of the crop of beet sugar of Europe for the current campaign, 1897, and the amounts of sugar produced during the last 3 years are tabulated.

The acreage of grains in Russia (*Mitt. deut. landw. Ges., 12 (1897), No. 9, pp. 55, 56*).—Statistical information concerning the crops of wheat, rye, and oats during the last 10 years.

May crop report (*Indiana Bureau of Statistics Bul. 1, pp. 1-4*).—A report on the condition of field crops and of fruit in the northern, central, and southern divisions of the State.

Danish cattle exports, J. ARUP (*Landmansblade, 29 (1896), pp. 256-262*).

NOTES.

Alabama Station.—J. T. Anderson, Ph. D., has been made associate chemist of the station.

Arizona Station.—Col. J. H. Martin, of Tucson, has been appointed a member of the governing board, succeeding E. R. Monk. H. G. Wolfgang, formerly foreman at the station at Tucson, has been made florist and assistant horticulturist, and F. G. Havens, formerly of Riverside, California, has been made foreman.

Ohio Station.—The dedicatory exercises of the Ohio Station were held at Wooster, June 3, in the presence of an audience estimated at from 10,000 to 12,000. A number of distinguished guests, including the governor, Asa S. Bushnell; the Assistant Secretary of Agriculture, Hon. J. H. Brigham, and others, were present and took part in the exercises. Among the addresses delivered were "The Ohio Agricultural Experiment Station: Its history and work," by Assistant Secretary Brigham; "The educational value of agricultural experiment," by W. I. Chamberlain, and "The evolution of the experiment station," by E. W. Allen, of this Office.

Seeds and Plants from Eastern Europe and North Central Asia.—Prof. N. E. Hansen, of the South Dakota Agricultural College, has been appointed by Secretary Wilson special agent to visit eastern Russia, Russian Turkestan, Bokhara, Siberia, east of the province of Irkootsk; Manchooria, and outer Mongolia in northern China, for the purpose of making as complete a collection as possible of grasses, cereals, legumes, fruits, and all kinds of farm, tree, shrub, and garden seeds from the very dry and hot semi-desert regions, as well as very cold and dry sections of these countries, with a view to securing hardy plants adapted to the arid sections of the West and the colder regions of the Northwest.

The Industrial Work of the Seaboard Air Line Railroad.—The industrial department of the Seaboard Air Line Railroad, whose main line extends from Portsmouth, Virginia, to Atlanta, Georgia, has organized under the supervision of John T. Patrick, chief industrial agent, a somewhat novel and extensive system of industrial instruction with a view to encouraging people along the line of the road to improve their methods of farming and to develop certain allied industries, such as canning, dairying, etc., which have hitherto received little or no attention. This work was inaugurated by the selection of local industrial agents who are representative men in the community and serve without pay. These agents directed their efforts first to stirring up interest in the industrial work of the railroad and to encouraging tree planting and village improvement. From this beginning has developed the one-day farmers' institutes, or industrial training schools, which have been actively prosecuted during the present summer. For the use of this school a train of cars has been fitted up with improved appliances for canning, preserving, pickling, butter making, tillage of the soil, and road making, and provided with accommodations for the force of instructors accompanying the exhibits. This train stops for one day at different small towns along the road. Opportunity is given for examination of the different implements and appliances and their use is explained. Instruction is also given in canning, preserving, etc., to a class of young ladies, and literature relating to improved implements and methods is distributed. Between June 28 and July 20

these schools were held at 13 different points in Virginia, North Carolina, South Carolina, and Georgia. Another feature of this industrial work is the attempt to improve the stock of the farmers along the road. The use of two thoroughbred Jersey bulls, and one Holstein bull is at present being given to the farmers free of cost. Other thoroughbred animals are to be added from time to time. The third feature of the work, which is not yet thoroughly organized, is to be provided for by the establishment of experimental farms every 10 miles, or 100 in all, along the line of the road. Twenty-eight of these farms have now been established. These farms are to be devoted principally to tests of the adaptability of various crops to the regions in which the farms are located. Hops, ginseng, Kafir corn, and pyrethrum are some of the crops being tested at present. The testing of fruits and grasses is to be given special attention in the future.

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THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. VIII

No. 12

EXPERIMENT STATION RECORD

UNITED STATES DEPARTMENT OF AGRICULTURE
1862 1889
AGRICULTURE IS THE FOUNDATION OF MANUFACTURE AND COMMERCE

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EXPERIMENT STATION RECORD.

VOL. VIII. NO. 12.

The present number completes the eighth volume of the Record. The character and extent of the work in this and the preceding volume is indicated by the following table:

	Volume VII.	Volume VIII.
Station reports	46	62
Station bulletins	304	340
Publications of United States Department of Agriculture	83	92
Foreign articles	443	702
Total number of articles	1,301	1,565
Classified as follows:		
Physics	1	....
Chemistry	144	157
Botany	43	69
Fermentation and bacteriology	4	5
Zoölogy	10	10
Meteorology	54	54
Air, water, and soil	54	55
Fertilizers	100	103
Field crops	206	228
Horticulture	111	154
Forestry	11	11
Seeds and weeds	41	29
Diseases of plants	64	79
Entomology	87	126
Foods and animal production	156	177
Veterinary science	36	51
Dairying	75	139
Technology	7	4
Agricultural engineering	18	22
Statistics	76	92
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The abstracts in this volume occupy 778 pages, and required in their preparation the reviewing of 38,552 pages in the original publications. In addition to this the volume contains 2,200 titles (mostly foreign), not abstracted; 15 editorials, occupying 26 pages; 9 special articles, occupying 118 pages; and 75 station notes, occupying 13 pages.

As in previous volumes the subject-index has been made in sufficient detail to serve as a fairly complete guide to the contents of the publications abstracted.

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INDEX OF SUBJECTS.

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